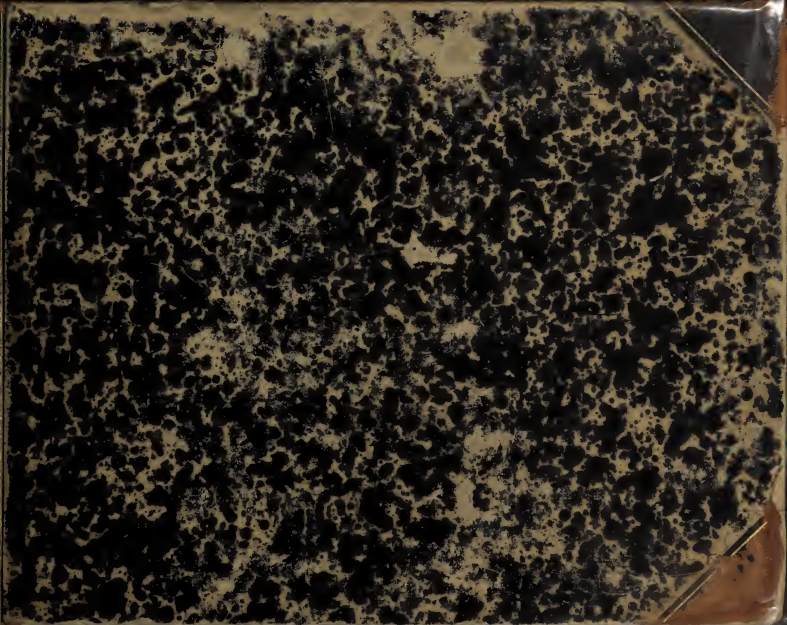


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INDUSTRIAL DRAWING

REVISED



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that if continued it would cut the line approached, the union is called a secant union.

BOOK No. 1
FOR FIRST HALF OF FIRST SCHOOL YEAR
FOR TEACHERS

WHITE'S
INDUSTRIAL DRAWING

REVISED



IVISON, BLAKEMAN & COMPANY
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Vol. 1

NOTE.

THE USE OF CLAY:—The most convenient and satisfactory method of teaching form to very young pupils is by the use of clay. Little children can themselves readily make from it almost any form they study, and it easily illustrates nearly every step of the early work of the course: it is therefore recommended in this course, and directions for moulding are given. In places where clay is not readily obtainable, or for any reason its introduction seems impracticable, any substitute may be used in its place. The sphere and spherical solids are readily illustrated by common fruits, and these, in the absence of clay, should be used for the purpose. The teacher may cut from apples, potatoes, or turnips the cube, the cylinder, the pyramid, cone, or, in fact, almost any illustrative solid which appears in these lessons, and such vegetable forms are hardly less valuable than those made of clay. Bar-soap may also be used in the same manner as vegetables in teaching form—soap having the advantage of being comparatively durable.

Good results can be secured with paper, card-board, or wood forms, if judiciously used: the indispensable essential being to impart clear ideas and accurate knowledge, whatever the method employed.

WHITE'S INDUSTRIAL DRAWING—REVISED.

BOOK NUMBER ONE.

LESSONS ON FORM.

WHY DRAWING SHOULD BE TAUGHT.

All knowledge depends upon perception, and perception upon three senses—sight, touch, hearing. Sight and touch are dependent upon form. The study of form, then, is one of the most important factors in early education. Drawing, in all its departments, deals with form, and it is impossible to teach drawing as it should be taught without a constant reference to the objects and forms studied.

In the public schools, drawing should be taught for the valuable training which it gives to the eye and hand, and for its educational value,—not for the amusement of the pupils, or for the production of “pretty things” in the forms of designs and pictures.

THE GENERAL PLAN OF THE WORK IS AS FOLLOWS:

- I. The study of forms as wholes.
- II. The analysis of forms and the study of their details.
- III. The producing of new forms, or new combinations of forms.

The details of form are taken up in the following order:

Points, straight lines, angles, triangles, squares, oblongs, curved lines, circles, ellipses, ovals, compound and reversed curves. Hexagons, octagons, pentagons, spirals.

In this little book, which is intended for the use of teachers in the lowest grades, the geometric forms, sphere, cube, and cylinder, and their applications, are the only forms taken up; and of the details of form, points and their positions, and lines.

THE OBJECTS OF THESE LESSONS ARE:

To lead pupils to see, to think, to express what they have perceived.

Very little should be *told* to the pupils. Ask definite questions, which shall lead them to think for themselves. Always present the form to be studied to the pupils, and study *it*, not study about it.

In order to obtain the best results, each pupil should be supplied with the following articles:

MATERIALS.

One sphere, 1 inch in diameter.

One cube, 1 inch on a side.

One cylinder, 1 inch in diameter and 2 inches long.

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One dozen sticks, 1 inch long, of each of the three primary colors — yellow, red, and blue.

One dozen sticks, 1 inch long, of each of the three secondary colors — orange, green, and purple.

A slate and pencil.

A mass of clay equal in size to a cube 3 inches square.

CARE OF MATERIALS.

When not in use, the materials, except the slates, should be kept by the teacher of the class; all the clay in a mass, and the other materials in small boxes.

It is important to have all the materials properly marked, and so arranged that they may be given out to the class without consuming too much time. Many ways of doing these things expeditiously are already familiar to most teachers. The practice of passing each article separately to the owner should not be permitted, as it takes too much time and creates confusion.

A very good way is to have the materials in small boxes, with each pupil's name on his box; to place the boxes on the end of each line of desks on one side of the room — the right side, for instance; each pile should contain the boxes belonging to the pupils in that line; as the teacher counts *one*, the pupil on the right-hand at the end of each line should lift the boxes, dropping the lower one, which should be his own, and place the others in front of his next neighbor; when the teacher counts *two*, the second pupil in each line should lift the boxes, dropping his own from the bottom, and pass them to the third pupil, who should

proceed in the same way as the teacher counts *three*, and so on to the end of the line.

After the lesson, when the boxes are to be collected, the same plan should be followed, — thus: beginning now on the left-hand, and counting *one* for the first pupil in each line to put his box on the box of his next neighbor, then *two* for the second pupil to put the two boxes on the box of the third pupil, etc. When the boxes are all collected on the right side of the room again, they may be collected by one pupil, and brought to the teacher, who places them in the closet. If kept in this way in the closet, the piles may be placed on the desks and counted back for the next lesson without any trouble of rearrangement.

The slate pencils should be long, and well pointed; they may be passed to the pupils in lines as described for the boxes. The pencils belonging to each line or row of pupils may be kept together by an elastic band; they should be looked over carefully after each lesson, and sharpened if necessary. One or two members of the class should be appointed to take care of the pencils, under the direction of the teacher; or, if the scholars are very young, the teacher should take charge of them.

The clay should be kept in an earthen jar if possible; if not, in moist cloths, and covered with a piece of rubber-cloth or gossamer. When ready for use, the clay has about the consistency of new putty, but is not soft enough to be sticky. If the clay is too hard to use, let it stand in water for an hour or more, and then expose it to the air for about the same length of time. If the clay is too moist, allow it to dry until it is in a proper condition to use. When the clay is to be used by the class, take a mass of it from the jar, of such a size that each pupil may have a piece about as

large as his cube. Form the clay into a cubical mass, and cut it into small cubes, as shown in Figure 1. Cut horizontally first, then make the vertical cuts, using a strong, fine string or a piece of wire. Distribute the clay, giving one piece to each pupil. When the lesson is over, collect all the forms modeled, select those to be preserved, and swedge



Fig. 1.

the others into a mass, ready for use in the next lesson. If the clay when collected is quite moist, it may be swedged into shape very readily by throwing it upon a hard surface a number of times; but if the clay has become somewhat dry, place it in a stout cloth, and let it stand in water a few moments, then twisting the cloth tightly around the clay, mass it in the cloth by throwing upon a hard surface as before.

With a little thoughtful care, the clay may be easily kept in a good condition, and the inconveniences of "liquid clay" and "lumpy clay" be avoided.

LESSONS ON THE SPHERE.

The sphere is taken first, because it is a form with which all children are familiar, and also because it is the simplest of the geometric forms to mould.

The steps in giving a lesson and the order of taking them should be the same in each lesson on form. They are here given.

1. **Introduction.**—Awaken the interest of the pupils. Have the attention of every one,—not by commanding it, but by introducing the subject in such a way that the attention will be given voluntarily. Make the introduction so interesting that even the dullest will be aroused. This may be done by making use of the pupil's previous knowledge, his curiosity, and his imagination. In the first lesson on the sphere the distribution of the forms will be sufficient to awaken interest—especially if the pupils are told not to touch them, but to look at them, and see what they can find out about them, for questions will soon be asked about what they can see.

2. **Study of the Form.**—Ask the pupils what the form is made of, how it looks, etc. Take the form in the hand. How does it feel? What will it do? and similar questions.

3. **Objects similar in Form.**—After the form has been studied as above, ask pupils to find objects in the room like the form; then to think of objects which they have seen like it.

4. **Teaching the Name.**—When the pupils are thoroughly familiar with the form, teach them its name, and give them practice in its use. The term Sphere is hard to teach, because nine-tenths of the pupils will call it "spear." Write on the board, S-fear. Have them pronounce S-, then "fear"; then put the two together, first slowly, as S - - fear—then S-fear and S fear, or Sphere. Ask questions like, What have you in your hand? (Answer, a sphere.) What is an orange shaped like? or, What is a ball shaped like? or, What is a marble shaped like?

5. **Expression.**—To be taken up in third lesson, by clay, and later by words and drawing.

Fix these five steps thoroughly in mind, and follow them in

giving the lesson, and there will be fewer *dull boys* in the class than usual during the time for drawing.

SECTION I.

LESSONS FOR ONE WEEK.

Four Lessons of Fifteen or Twenty Minutes each.

Lesson 1.

The Sphere — Provide objects having the form of the sphere, and place in different parts of the room. Distribute spheres to the pupils. If models are not at hand and cannot be obtained, marbles or balls will do. Proceed with the lesson as already indicated.

Lesson 2.

Review previous lesson. Make the lesson interesting by thinking of new forms similar to the sphere; by thinking of all the things good to eat which are like spheres; or of all the largest spheres the pupils have ever seen; or the smallest.

Lesson 3.

Moulding.— (For hints on management of clay, see page 5.) After the clay is distributed, review quickly the form to be moulded. Then, taking the clay in the left hand, push in the corners with the thumb of the right hand. Now, with the hands open flat, roll the clay between the palms, gently and quite rapidly, round and round, until the sphere is formed. Test the spheres moulded, by rolling, by standing, by comparing with the models.

Collect the forms moulded, select those which are to be preserved, and mass the others. Clean the pupils' hands if necessary by using a large sponge or moistened cloth.

Mark the spheres while moist with the initials of the pupils who made them, using a pin or sharp stick. Make the letters small and fine.

Lesson 4.

Review the moulding of the sphere, striving to obtain better spheres than before; then model some object like a sphere. Select some simple object, an apple, orange, cherry, etc., and have the sphere modified so as to be as near like the form as possible. Model the form with the fingers. Bits of wood, pegs, or apple stems saved from the children's lunches may be used to form the stems to the apples, or toothpicks for cherry stems, etc., etc. The teacher's ingenuity will help her in these lessons, and the little people will be found right willing to assist her in obtaining material either for models or for accessories in these form lessons.



Fig. 2.

Figure 2 illustrates a few of the many forms which may be modeled.

SECTION II.

LESSONS ON THE CUBE.

The cube is studied next to the sphere, because it is the opposite of the sphere, and the details of each are made more prominent by contrast.

Work for One Week.

Lesson 1.

1. **Introduction.**— Provide forms based on the cube, and place in different parts of the room. Distribute cubes to pupils. Interest the pupils in the new form, and review sphere rapidly.

2. **Study of the Form.**— Ask questions similar to these: Of what is this model made? How does it look? How does it feel when held in the hand? What will the block do? Will it roll? Can it slide? Can it be made to slide without touching it? (Yes: on a book or slate held obliquely.)

3. **Similar Objects.**— Find objects similar in the room. Think of similar objects. There are not so many simple forms based on the cube as upon the sphere, but the pupils will think of a number quite readily.

4. **Teaching the Name.**— Write the word *cube* on the board, and tell the pupils that a form like the one which they have been studying is called a *cube*, not a "cue," as many will say. Be careful to have the pupils pronounce the word correctly. Ask questions in such a way as to require the use of the term in the answer.

Lesson 2.

Review of the cube, similar to the way in which sphere was reviewed in the second lesson. Bring out *cubes* by using more than one cube at a time. When the pupil mentions objects based on the cube, make pictures of the forms on the board.

If you cannot draw *well*, don't be afraid to *try*. Any sketch which hints at the form, even if it has but the remotest resemblance to it, will be found enough to satisfy the child. Children's imaginations are powerful, and a hint in the right direction is enough to call to their minds a vivid picture of the reality. Sketches upon the blackboard by the teacher will double the interest in a lesson. Compare with the sphere.

Lesson 3.

Moulding.— Distribute clay and models as for sphere. Review cube.

The cube is best moulded by first forming a sphere rapidly, and then, holding it between the thumb and fingers, striking it gently upon the slate three or four times. Have the pupils do this in concert. Turning it, strike the opposite side in a similar manner, and so on until the cube is formed. The corners and edges may be sharpened if necessary by drawing the clay out a little between the thumb and forefinger.

Test the form moulded by comparing with the model.

Lesson 4.

Review the moulding of the cube, as it is more difficult to obtain good results with the cube than with the sphere. An application of the cube should not be attempted until the third or fourth lesson.

SECTION III.

LESSONS ON THE CUBE.—*Continued.**Work for One Week.***Lesson 1.**

Review cube again, and mould. Strive for a correct expression of the form by clay. This should be a lesson on telling the exact truth. The model has six sides alike, sharp edges and corners, and the pupil is to make one like it. Then, if the edges of this cube are not sharp and the sides alike, it is not a true story about the cube. Let each pupil strive to make the best cube.

Lesson 2.

Select some simple application of the cube (see Figure 3), and have the pupils mould a cube; then the application; mould in concert as in previous lessons.

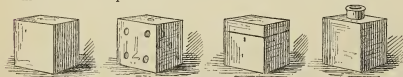


Fig. 3.

Lesson 3.

Distribute the clay, and after reviewing the cube and moulding it, let each pupil select some form based upon the cube, and mould it, without any help from the teacher.

If the clay should become dry before the object is moulded, it may be sprinkled with water to moisten it.

Lesson 4.

Review.—Give each pupil a sphere and a cube. Have the two compared. Ask some pupil to tell all he can about one or the other. Place the sphere on the cube. Ask if any objects have been seen like these two forms combined.

Strive for a correct expression of the forms by words.

SECTION IV.

LESSONS ON THE CYLINDER.

The cylinder combines the qualities of both the sphere and the cube, and for that reason is taken next.

It is the most difficult of the forms to mould.

*Work for One Week.***Lesson 1.**

1. Introduction.—Provide objects based on the cylinder, and cylinders of various proportions: As a lead pencil, a sage box, a pill box, and a lozenge. Review the sphere and cube.

2. Study the Form.—Ask questions to bring out the following: A cylinder is round, with flat ends; it will roll and stand like a sphere, and slide and stand like a cube.

3. Similar Objects.—Pupils find objects based on the form in the room. Bright eyes will find many. Be careful to keep the bright boy from naming a dozen of the most evident, before the dull boy finds one.

Teaching the Name.—This term *cylinder* sometimes proves to be difficult. "Cynilder," "cyndiler," and "clynder" are common.

To overcome this difficulty, write the word on the board. Cyl-in-der, and have each syllable pronounced separately. Give practice in the use of the term, as was before given for sphere and cube.

Lesson 2.

Review the Cylinder.—In this lesson bring out the term *cylinders*. Find objects formed of two cylinders united, as a mallet, the elbow of the stove-pipe, a bottle, etc. Find largest cylinder and smallest cylinder, making sketches on the board to illustrate.

Lesson 3.

Moulding.—Cut the clay into masses a little larger than usual. Distribute the clay and the cylinders. Review rapidly. Mould a sphere, then change to a cylinder by rolling carefully on the slate with the palm of the hand. The flat ends are obtained by striking the clay upon the slate squarely and firmly, as the sides of the cube were formed.

Figure 4 illustrates the popular forms of cylinders during the first two or three lessons. A form like Figure 4, *a*, shows that the clay was rolled too hard; like *c*, not hard enough; *b* is the usual form, and shows that the clay was rolled too much before it was struck upon the slate to form the ends. A little care, however, will soon correct these faults, and good results will be obtained.

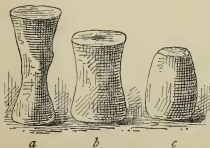


Fig. 4.

Lesson 4.

Review moulding, each one trying to make the *best* cylinder.

SECTION V.

LESSONS ON THE CYLINDER.—*Continued.*

Work for One Week.

Lesson 1.

Review Moulding of the Cylinder, urging the little workers to do even better than in the last good lesson. Take a piece of clay and work with them, comparing your work with theirs. If any of them can “do better ‘n teacher,” they will be delighted, and think all the more of their teacher besides.

Lesson 2.

Mould Applications of the Cylinder.—Figure 5 illustrates a few of the many objects based upon the cylinder.

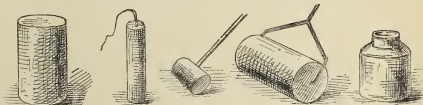


Fig. 5.

Lesson 3.

Review Sphere, Cube, and Cylinder, and mould Applications of any or all of the Forms, each pupil selecting a form to mould. (See Figure 5.)

Let a few make a string of beads — each pupil making one bead. Or a few others a croquet set, or a string of grapes, or a basket of different kinds of fruit.

Lesson 4.

COLOB. Materials: Circles of Colored Paper, Colored Chalk, or Balls of Colored Worsted, and the Colored Sticks for the Pupils. — In the color lessons, which will be found through the course, be careful to teach a few things thoroughly at each lesson. The usual mistake is to try to teach too much. In this first lesson find out what the pupils know. Try white or black; if these are already known, take red. Place some red marks on the blackboard, and objects having the color in different parts of the room.

Hold the circle of red paper before the pupils, and ask them to notice its color. Tell them that they must look at it carefully, for you are going to see if they can remember its color. Put the circle out of sight, and hold up some other object of the same color. Question the children about it. Try it again — this time showing them two or three other colors before again showing red. Ask them to find anything in the room the same color as the first circle they saw. Perhaps they will see the red mark on the blackboard, the geranium blooming near the window, Jenny's dress, Harold's necktie, or the ribbon on Marion's hair. When objects have this color they are *red*; never mind what *shade* of red at present, simply the comprehensive term *red* is to be given. Strive now to associate the color and its name, by asking questions which will lead the pupils to make use of the term *red* in expressing thoughts about certain things.

SECTION VI.

LESSONS ON THE HEMISPHERE.

The three simple geometric forms, sphere, cube, and cylinder, have now been studied. The analysis of the forms comes next in order.

First, the sphere is cut in two, thus forming hemispheres.

Work for One Week.

Lesson 1.

1. **Introduction.**—Provide objects similar to the hemisphere, and place in different parts of the room. With a large sphere of clay, an apple, or if possible a wooden sphere cut in two, teach hemisphere.

2. **Study of the Form.**—By questions lead the pupils to discover the shape of the form: that one side is flat and the other rounding; that it will roll on its edge, will stand and slide on its flat side, and stand and rock on its rounding side; that two of them make a sphere.

3. **Objects Similar.**—First find similar forms in the room, then think of objects similar; then of objects which might be cut so as to make the form.

4. **Teaching the Name.**—Give the name Hemisphere. Tell them that *hemi* means half, and that hemisphere is really half-sphere. Give practice in use of term.

Lesson 2.

Moulding.—Distribute clay and spheres. Review sphere and mould. Review hemisphere. Distribute thin, stiff cards, about $1\frac{1}{2} \times 2\frac{1}{2}$ ins. in size, and show the pupils how to cut the spheres into two hemispheres. Place the sphere in the hollow of the left hand. Then holding the card in the right, as shown in Figure 6, cut the sphere through the center.



Lesson 3.

Review.—Mould the sphere and cut to form the hemispheres as in Lesson 2. Strive for accurate work, in both moulding and cutting.

Lesson 4.

MOULDING APPLICATION OF THE HEMISPHERE.

First mould sphere and cut. Distribute two tooth-picks to each pupil. Give directions for making a ladle.

Place a hemisphere in the hollow of the left hand with the flat side uppermost. Make a little hollow in the flat side by gently pressing the finger upon it once or twice. Insert the tooth-pick for the handle.

The pupils may now make any other application of hemisphere they may think of. Perhaps a sunshade, a toadstool, a

little skillet, or a bird's nest, or nut-shell, half a peach or half an apple. This last may be made quite natural in appearance by inserting a real apple-stem and real seeds.



SECTION VII.

LESSONS ON DETAILS OF FORM.

Thus far forms have been studied as wholes. These forms are now analyzed and their details studied. Forms are analyzed and their details studied in the following order: surfaces, faces, edges, corners.

Work for One Week.

Order of lesson in Analysis:

1. *Review* of form to be analyzed.
2. Call attention to the different parts, and especially to that detail to be studied during the present lesson. Observe by eye and hand. Ask questions concerning it, so as to bring out its characteristics.
3. Study from other forms and objects.
4. Give name or term.
5. Give practice in use of the new word.

Lesson 1.

A SURFACE.

1. Review sphere, cube, and cylinder.
2. Placing the hand on the sphere, ask, What am I touching? What part of the sphere am I touching? (The outside.) Touch the outside of the cube, the cylinder, etc. How does the outside of these forms feel? What can you do to the outside with your hand? (Rub it, touch it, or move the hand over it.)
3. Find anything else over which the hand may be moved. (The desk, slate, chair, blackboard, wall, book, etc., etc.)
4. Anything upon which the hand may be moved is called a *surface*. Teach the term, being careful to obtain a correct pronunciation.
5. Ask questions in the answering of which the pupils must make use of the new word. For instance: When I move my hand on the blackboard, what do I touch? On the book? etc. A sphere has one surface; a hemisphere two; a cylinder three; a half cylinder four; a square pyramid five, etc.

Lesson 2.

1. Review surface.
2. Using various forms, as the sphere, a book, an apple, and a box. Bring out the fact that the fingers move along one surface, or back and forth upon it, while on another they move around. For instance: The fingers move along on the surface of a slate, but around on that of an apple.
3. Find these two kinds of surfaces in the room.

4. A surface upon which the fingers move along, a flat surface, is a *plane surface*; a surface upon which the fingers move around, a surface which bends, is a *curved surface*.

5. Question the pupils as to various surfaces so as to require the use of the terms often.

Find largest or the smallest plane surface and curved surface in the room.

Lesson 3.

MOULDING OF SURFACES.

Distribute two pieces of clay and one card to each pupil, using one piece of clay. Mould a sphere. Study its surface. With the card, cut the sphere. How many surfaces has the hemisphere? What kind are they? etc. With the other piece of clay mould a cylinder. Study it as to its surfaces. Cut lengthwise. Study each half. Using the clay in one hemisphere, the card and the clay in one half cylinder, construct the "little bridge" shown in Figure 7.



Fig. 7.

How many curved surfaces has it?

Other similar exercises may be given.

Lesson 4.

Color.—Review black, white, and red; then study yellow as red was studied. (See Section V., Lesson 4.)

SECTION VIII.

LESSONS ON THE DETAILS OF FORM.

Face.—*Note.* After much careful thought and study, it has been thought advisable to teach *Face* as simply "the plane surface of a solid." Any other definition is perplexing to young children.

*Work for One Week.***Lesson 1.**

1. Review plane and curved surface.
2. Notice that when a sphere is held in the hand in one position, it is impossible to see where the surface stops, or to see the whole of the surface at once; the same with the curved surface of a cylinder. When a cube is held in the hand, the whole of one side may be seen, and the surface is smooth and flat.
3. Find other plane surfaces, of which the whole may be seen at once.
4. The plane surface of any form when completely visible is called a face.
5. Find faces, and use the new word in both questions and answers.

A sphere has no face; a cylinder has two faces and a curved surface, a cube has six faces, etc.

Lesson 2.

As the new term face may be found somewhat difficult for the pupils to remember, in this lesson review the subject carefully, cutting a slice from an apple to form a face, or dropping a sphere of clay upon a flat surface to form a face. Make sketches on the board of the various faces found by the pupils,—long faces, wide faces, round faces, etc.

Lesson 3.

Distribute the clay. Review face. Ask the pupils to mould any object they can think of which has a face. Make the representation of the objects as natural as possible.

Lesson 4.

Color.—Review red and yellow, and take blue, teaching it in the same manner in which red and yellow have been taught. (See Section V., Lesson 4.)

SECTION IX.

LESSONS ON DETAILS OF FORM.

Edge.*Work for One Week.***Lesson 1.**

1. Review plane and curved surface and face.
2. Place a cylinder upon a book, and inclining the book a little, let the cylinder roll off the book and drop into the hand. Ask, What made the cylinder drop? (Probable answer—"It rolled off.") Place a cube upon the book and push it off; then let it slide off, asking each time, What caused it to drop off? When the cylinder is rolled, why does it not keep right on rolling and not drop? Ask such and similar questions, to bring out the fact that the surface stops, thus causing the objects to fall.
3. Find other places in the room where surfaces stop.
4. Where a surface stops, an *edge* is formed.
5. Give practice in the use of the new word, and notice that every edge is formed by the stopping of one surface and in most cases by the beginning of another.

Lesson 2.

Review lesson one, and by questions and illustrations bring out the difference between straight and curved edges. Notice that two plane surfaces coming together form a straight edge; that a plane and a curved surface coming together form a curved edge; two curved surfaces, a curved edge, etc.

Lesson 3.

Review, finding long and short, straight and curved edges, edges with long curves, short curves, etc.

Lesson 4.

Color.—Review the three colors studied, red, yellow, and blue, and have the pupils use their colored sticks, arranging all the red in a row, all the yellow, all the blue. Make a row, using first a red, then a yellow, then a blue stick, then a red, and so on.

Give other exercises similar.

SECTION X.

LESSONS ON ANALYSIS OF FORM.

Corner and Its Picture, a Point.

Work for One Week.

Lesson 1.

1. Review edges.
- 2 Using a book or box cover to illustrate, question pupils as to its edges. Have them move their fingers along two adjacent

edges until they meet. Notice where the edges run into each other or meet.

3. Find edges in the room which meet. Find edges which run into surfaces and stop; and by questions lead pupils to discover that a corner is formed where two or more edges meet.

4. Teach the new term *corner*.

5. Use the word in questions and answers.

Lesson 2.

Review corner and teach the drawing of the corner.

Select some corner in the room and tell the pupils that you will make a picture of it upon the board.

Place upon the board as its picture simply a point or dot. If any lines are drawn you have more than a picture of the corner, for portions of the sides have been drawn.

Ask some pupil to make a picture of a corner upon the blackboard—not a picture of *any* corner, but of some *particular* corner. Ask others to make similar pictures of corners.

In the first work of the little people, six kinds of dots, illustrated in Figure 8, will probably be found. Say little about it, however, during this lesson; simply keep the little mind occupied with one fact,—that a point is the picture of a corner.

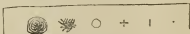


Fig. 8.

Lesson 3.

Review, making points, pictures of corners. Make a number of such pictures on the board. Ask the pupils to make one on

their slates. Pass through the aisles and notice the various kinds of dots. Ask how many points are upon the blackboard. How many *kinds* of points? (Only one kind.) Tell them that you have found two or three kinds, and draw the different kinds on the board. Show them why some are wrong and others right. Teach them how to make the *best* points—small, like the last in Figure 8.

Lesson 4.

Color.—Review the three colors, red, yellow, and blue, making sketches of simple objects upon the board and allowing the pupils to color them with the three colors.

Give the term *Primary*. These colors are called primary because no other colors can be mixed so as to make any one of them. Illustrate what is meant by mixing colors, in the following manner: With a yellow crayon make a number of heavy marks close together upon the blackboard; close to these make a number of blue marks; with the finger blend them together by rubbing gently. A green will be the result. So, green is made of two colors—blue and yellow. Red or yellow or blue cannot be made in any such way, so they are first or primary colors.

Ask questions about different objects, having one or more of these three colors upon them, in such a manner that the term Primary Color may be used, and the children become familiar with it. Continue until the three primary colors are known at sight and the meaning of *primary*, with reference to color, understood, as the meaning of primary is understood when it refers to schools.

SECTION XI.

LESSONS ON POSITION OF POINTS.

Work for One Week.

First teach simply the positions without having pupils make points.

Lesson 1.

Slates upon the desk, with long edges parallel to long edges of the desk. All sit up straight. Hold up the right hand. (The teacher being careful to hold up her *left*, because what is *right* to her appears to be *left* to the little eyes in front.) Now, can everybody do like this? (Figure 9, pointing straight up with the forefinger.) Now, all together, put the finger down on the *middle* of the slate. See that every finger is in the right place. All hands up again; now, all together, finger on the middle of the slate. Practice this until perfect unison is obtained. Now, move the finger from the middle or *center* to the top of slate. Then center, top, bottom, top, bottom, center, bottom, center, top, etc.; first slowly, then more rapidly. Try it upon the top of the desk or upon a book—for variety.



Fig. 9.

Lesson 2.

Review center, top, and bottom, and add left side and right side, having pupils work in perfect unison. It may be necessary to call the pupils' attention to the fact that the left is toward the window and the right toward the blackboard or some such local objects, to fix in their minds which is left and which right.

Lesson 3.

Review the five positions, skipping about, going first slowly, then more rapidly. In this lesson turn the slate with the short edge toward the top, so that the pupils will know that its position upon the desk makes no difference; that top means farthest away, and bottom nearest; and that left and right are positions relative to themselves, and not to the slate or book.

Lesson 4.

Review the same, being careful to have the fingers find the *middle* of the top, *middle* of the left side, etc. Review often.

SECTION XII.

LESSONS ON POSITION OF POINTS.—*Continued.*

At this stage of the work the use of "men" will be found of great assistance in teaching positions, etc. By "men" are meant pieces of wood about the size or shape of "roll lozenges," or buttons, or kernels of Indian corn. Each pupil should have twelve "men." These will be found not only useful, but intensely interesting to the children; for they are now flies, now frogs, or trees, or boys, or soldiers, as the teacher suggests.

Work for One Week.

Lesson 1.

Review center, middle of top, middle of bottom, middle of left

side, middle of right side, using "men." Make the lessons interesting. For instance: We will play that the slate is our field and the frame the fence around it, and in the field we are going to set out some trees. We must have them in just the right place every time. Each tree must be set out right the *first* time, because we can't set out the same tree twice, very well. Now, see who will have the best-looking field. First tree in center of field, next middle of left side close to the fence, middle of right, etc. The teacher will readily think of many similar ways of making the lessons enjoyable. We remember longest what we learn with pleasure.

Lesson 2.

Review rapidly the five positions already studied, and add upper right corner and lower right corner. Holding a slate before the pupils, place your forefinger on the right side of the form; ask—Where is my finger now? (Ans.—"Right side.") Now moving it up to the top of the right side, ask—Where now? (Probable answer—"At the corner.") Which corner? (Probable answer—"Right corner.") Moving the finger to the lower right corner, ask, But isn't this a right corner too? ("Yes.") Moving the finger to the top again, ask—Then if both are right corners, which right corner shall we call *this*? (Ans.—"Top right corner, or upper right corner.") Right; and this? moving the finger to lower right corner. (Bottom right corner, or "downer" right corner, or lower right corner.) Ask pupils to point to the different positions in concert, skipping about from one position to another, so as to require the greatest amount of thought.

Lesson 3.

Review last lesson and in a similar manner teach upper left and lower left corners. Use the "men."

Lesson 4.

Review all the positions, first having the pupils point to them in unison, then placing "men" according to directions,—sometimes using the nine "men" for the nine positions, then dictating two or three of the positions only, so that there is a chance for a misplacement of the "men"; or, set out all the nine trees and have two or three of them die, and so that they must be dug up.

SECTION XIII.

LESSONS ON BISECTING.

Bisecting is cutting in two equal parts. Teach by cutting strips of paper, by breaking splints, by using pupils, etc., etc.

Work for One Week.

Lesson 1.

Ask Johnny, who sits in the first front seat, to stand in front of his desk, and Jimmy, who sits in the last front seat, to stand in front of his. Ask if there is a boy in the room who thinks he can stand just in the middle between Johnny and Jimmy. So out

comes Sam, and stands proudly up in the middle. Is he *just* in the middle? Let's see. Have a long string and ask some smart fellow to help measure. Measure from the top of Jimmy's head to the top of Sam's, and then from the top of Sam's to the top of Johnny's. Do they measure just alike?

Try the girls the same way. Now we will play that the slate is the floor. Select one piece of corn or one "man" for Johnny,—he came first,—and put him at the left side; now one for Jimmy, at the right side. Now be careful to put Sam half-way between so that they will measure just right.

This is bisecting. When we divide a distance into two parts just alike, we bisect it—not "bi-set." Teach the word correctly.

Lesson 2.

Review. This time, perhaps, sketching on the board, two birds on the telegraph wire and another to bisect the distance between them, or two boys on a fence, and a third to bisect, having the children follow upon their slates, using the "men" to represent the birds or the boys or the trees or whatever the lesson is about.

Lesson 3.

Review. This time, after the "men" have been placed in position, lift each up a little and place a point on the slate just under it, then remove the "man" entirely. The point must be made but *once*—no erasing.

Lesson 4.

Bisecting without the "men."—Take special care to have

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Fig. 11.

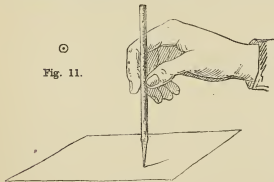


Fig. 10.

the points very small. Figure 10 shows position of hand and pencil while making a point. Figure 11 shows a little point "with a fence around it" or a little ring around it to make its position on the slate more evident. Make the points small and the little rings round.

SECTION XIV.

Lessons for One Week.

Lesson 1.

Review sphere, cube, and cylinder, and mould applications of the forms. Allow each pupil to select his own form to mould and his own application.

Lesson 2.

Color.—Review the primaries and teach orange. The best way to teach orange is to make the color before them. Take

a lump of gamboge, which may be obtained at any apothecary's for a cent or two, and dissolve it in water; it will form a beautifully yellow color. Have this in two clear glasses upon the desk; pour into one some red ink, stirring it with a stick; add a little red at a time until a brilliant orange is formed. Compare this color with the yellow in the other glass and with the red in the bottle. Find colors in the room similar to the color just made, and give the name orange—a secondary color—so called because it is made from two first or primary colors.

Lesson 3.

Review surface, edge, and corner, points and bisecting,—placing points on slates, and bisecting distances between points.

Mark the slates—a star for perfect, 1 for good, 2 for fair, and 3 for wrong.

Lesson 4.

Color.—Review the three primaries and orange. Teach green and purple as orange was taught; *i. e.*, by producing the colors before the pupils. For the primary blue use Prussian blue, or if that cannot be had use bluing, sometimes used in rinsing water.

Blue and yellow make green, and blue and red make purple or violet. Use colored paper and colored crayons in trying the various colors, to see if the pupils can associate the names with the proper colors. Review often.

SECTION XV.

LESSONS ON THE JUDGMENT OF DISTANCES.

The power to judge distances accurately is exceedingly valuable to any person. In the drawing-books of this series no guide-points are given, so that the ability to judge short distances accurately is absolutely necessary. One inch is taken for the standard at first.

Work for One Week.

Lesson 1.

Teaching "Inch."

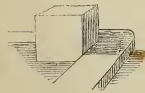


Fig. 12.

Make a similar point at each corner of the slate. Review.

Lesson 2.

Place the cube on the upper left-hand corner of the desk and don't touch it again until permission to do so is given. Look at

the cube carefully and try to fix in mind just how far it is from one of its corners to another.

Place a point one inch from the corner of the slate as in last lesson, but "guess at it"—do it by judgment; don't measure. Review.

Lesson 3.

Same again. The teacher working with the pupils and encouraging them.

Strive to place the points accurately the first time. Allow no erasing whatever. Put the little rings around the points.

The teacher to rank the work after the lesson.

Lesson 4.

Color.—Review of the primary and secondary colors, using the sticks. Figure 13 illustrates one method of using the sticks.

Place, for instance, the yellow stick upon the desk and near it the blue. The primaries yellow and blue united form green. Then a green stick is laid across them. Same with other colors.



Fig. 13.

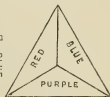


Fig. 14.

Figure 14 illustrates a similar arrangement, using colored paper triangles instead of sticks—the two slanting primaries forming the lower secondary.

The teacher will think of a number of similar exercises.

SECTION XVI.

LESSONS ON LINES.

Lines are pictures of edges. As edges go from one corner to another, so lines go from one point to another.

Work for One Week.

Lesson 1.

Review edge, corner, and point, and teach *line*, the picture of an edge. Select some object—a book, perhaps; ask a pupil to come to the board and make a picture of one corner; call another to make a picture of another corner. Question the pupils about the edge between these two corners, its direction, etc. Ask them the easiest way to make a picture of the edge, now that they have the two corners drawn. Ask some one to come to the board and draw the line connecting the points. Others draw similar lines.

Lesson 2.

Review last lesson on the slates, using the cubes; place points one inch apart,—pictures of two corners of the cube, then draw a line connecting the two points; draw other edges of the cube in a similar manner; no erasing or ruling allowed.

Lesson 3.

Review of drawing lines.—Figure 15 illustrates the quality of line for which to strive. The points in the first are too large.

In the second the pupil did what was required of him, *viz.*, to make the points very small,—to start at the left side and

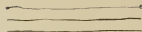


Fig. 15.

draw without stopping to the right—freehand and no erasing. This perhaps is the best line he can draw at present, but never mind; he made it *right*, and the quality will improve with practice. His mind thought right, and his hand will soon do right.

Lesson 4.

DICTATION LESSON.

Place a point in center of slate. Place a point one inch from the top of the slate. Draw a line from one point to the other. Place a point one inch from the bottom of the slate. Draw a line from the middle point to the bottom. Place a point one inch from the left side of the slate. Place a point one inch from the right side of the slate. Draw a line from the left point to the right. Result—a cross.

Give such simple exercises as the above, simply giving all directions with no help by sketches on the board; thus training the pupils to think and act for themselves. Assure them that if they *listen* to what their teacher says and do the best they can, they will do just right.

If these lessons do not occupy all the time allowed for drawing during the first half-year, give simple exercises on the subjects already studied, and review color carefully.

Keep the children interested in their work, make it pleasant for them. Don't discourage first attempts, be they never so poor. In short, to teach children be a child yourself.

Exercise II. BISECTING.

Bisecting a line is dividing it into two equal parts.

INSTRUCTIONS TO THE TEACHER. 1. Teach bisecting with blocks, say, 10, 20, 30, then with paper.
2. Place points one inch from each corner of the space below. Place points in center. Equalize distances between the upper points, between the lower, the left side, the right side. Equalize distances between the center point and upper left point, between the center and upper right, lower left, lower right as shown in illustration.



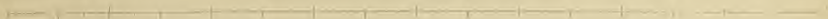
Exercise III. HORIZONTAL LINES.

A horizontal line is a level straight line.

Touch from objects, draw on them.

Exercise IV. This point has just been well covered by you. Draw objects (concentric circles) round it. Touch each of these inches — same to right side of page.

Measure movement and draw horizontal lines in space below, as indicated. Touch at bottom each, and then right line.



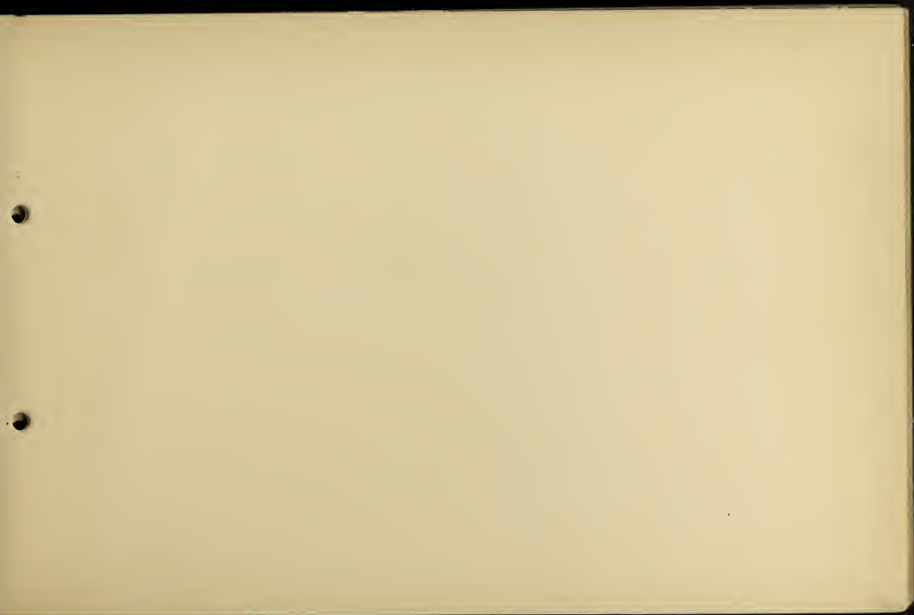
Exercise V. VERTICAL LINES.

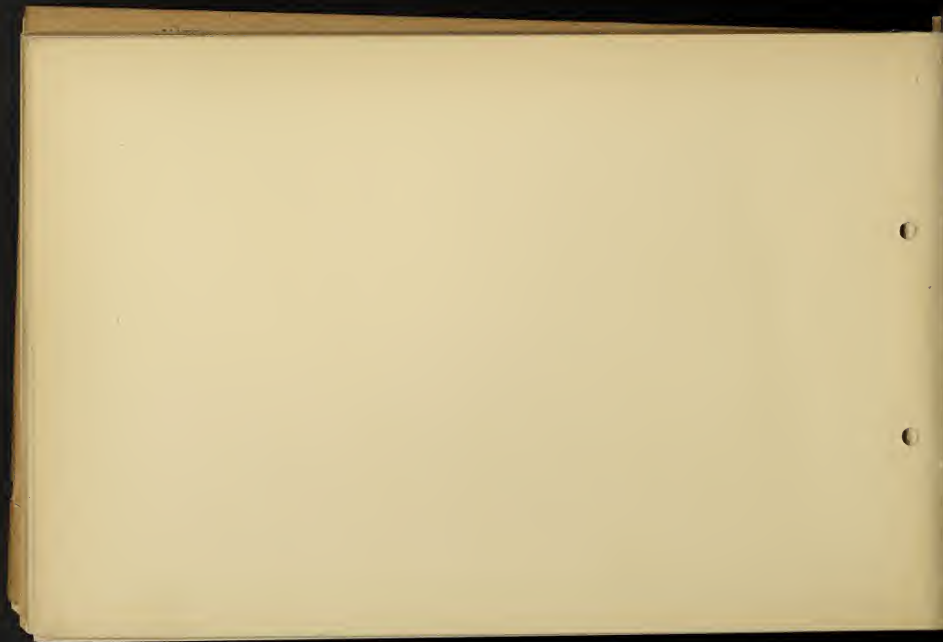
A vertical line is an upright straight line.

Teach from objects, and draw on slates.

Exercise VI. Place points one inch from the corners of the slate below. Bisect distance between upper points. Bisect each half of the distance. Bisect each of the spaces thus formed. Bisect the resulting spaces. Connect between lower points. Practice movement, and draw vertical lines in unison, light, free lines.







Exercise VII. Study the faces of a cube. Notice the edge boundaries and how they are related to the faces of the cube. Divide the space before into five equal parts by a vertical. In each space make a picture of one face of a cube. Make a cube and draw the lines.

Think before placing a point. *Think* before drawing a line.



Exercise VIII. APPLICATION OF VERTICAL AND HORIZONTAL LINES.—A Chair.

DIRECTIONS TO THE TEACHER. Place points one inch from each corner of space at right. Draw long vertical line and bisect it. Bisect distance between points at the right. Draw right vertical line and bisect it. Complete as shown in illustration.

Exercise IX. DICTATION.

Place points one inch from each corner of space below. Bisect distance between points at top, and then bisect each half at the top. Erase the outside points and the center point. Connect the two remaining points by a horizontal line. Connect the points at the bottom by a horizontal line. Bisect this line, then bisect each half of it. Draw vertical lines from ends of upper horizontal to points on lower horizontal line. Result, a hat.

Exercise X. OBLIQUE LINES

An oblique line slants or leans over.

Any line not horizontal or vertical is oblique.

DIRECTIONS TO THE TEACHER. 1. Teach from objects. Use edges in room, string, pointer, etc. Contrast with horizontal and vertical. 2. Place points one inch from each corner of space below. Bisect distance between them. Draw oblique lines connecting the points in as many ways as possible. Insist upon free work.





APPLICATIONS OF OBLIQUE LINES

Exercise XI.
DIRECTIONS TO THE TEACHER. Cut an arrow-head as shown in illustration, from paper, one inch wider than six by six inches long. Have drawing made from it in left half of space above. Give pupil similar directions, but to bisect each side and point each side in middle of top of space.

Exercise XII.

1. Cut a spear-head as shown in illustration, from paper, one inch wider than six by six inches long. 2. Have drawing made from it in right half of space above. Use blackboard to illustrate if necessary. First pupil starts on left and points, one inch from center towards right edge.



Exercise III. AFFIRMATION OF THE WORK AND OF LINES.

DIRECTIONS TO THE TEACHER. 1. Draw a dog kennel, as shown in diagram, on the blackboard, and explain. 2. Have it drawn in pencil on paper. From points one inch apart make corner. Draw distance between points as long, then between points at sides. Draw the outer vertical lines and the lower horizontal line. Place distance between upper ends of vertical lines one third length of the distance, and connect these ends with a horizontal line. These vertical lines downward from top ends. Draw the sloping lines.

Exercise XIV. After each pair is made up of pencils, colored sticks or toothpicks, and will have to arrange them on page 10 so as to represent every common object. For example, the chair on page 6 may be made by using five toothpicks. The hat, resulting from the discussion on the same page, may be made by using three toothpicks and two erasers.

After the sticks are laid, place a point at each end of each stick, remove the sticks, and draw a line in the place, thus representing the picture in the page.

TO BE USED AS THE TEACHER THINKS BEST.

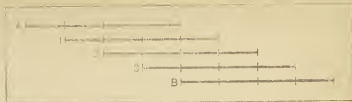
For Review or Examination.

Exercise XV. QUADRISECTING.

Bisecting a line and bisecting each half, or dividing into four equal parts, is quadrisecting.

DIRECTIONS TO THE EXERCISE. 1. Use blocks or pins for the pins or screws and line for the string. 2. First points on half only from compasses, others as shown in diagram. Use same rule for repeat the work in the second space given below. Strive to be more accurate than in the first.

NOTE: Point B is found half way between the points in the lower corners of the space. Points 1, 2, 3 are found by quadrisecting the distance between points A and B. Find other points in same way.



Exercise XVI. PARALLEL LINES.

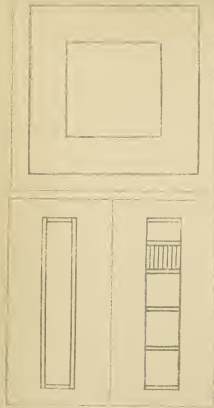
Parallel Lines are those which lie side the same distance apart at all points.

DIRECTIONS TO THE PUPIL.— Draw first four straight lines from the center of the compasses on the horizontal line. In the space below, the pupil is to draw four parallel lines of equal length about which he has decided. Draw four straight and four curved lines the space. Draw several lines.



Exercise XVII. APPLICATIONS OF PARALLEL LINES.

DIRECTIONS TO THE TEACHER. 1. Have these applications drawn first on slates, then select two of them, and have them drawn in spaces at right. Points for positions of drawings, by half-inches and inches as shown in illustrations.



Exercise XVIII. APPLICATIONS OF PARALLEL LINES.

DIRECTIONS TO THE TEACHER. Either cut a frame from paper six inches square with sides one inch wide, and have a drawing made from it in space at right, or divide the space, as shown in lower illustration, and make two drawings from a large book. Draw the front and back edges as shown. Points for corners one inch from sides of space, and one-half inch from top. Bottom same.

Exercise XIX. PERPENDICULAR LINES.

Lines forming a square corner are perpendicular.

DIRECTIONS TO THE TEACHER. 1. Teach from objects. Pupils draw at board. Then have them draw in the space at



the right either the face of a cube standing upon one corner, as in the upper illustration, or the figure given above, the oblique lines in a square.

If the cube is selected, have it drawn as large as the space will allow.

If the lines in the square, place first points one inch from corner. Before drawing this figure the pupils should study carefully, and discover how to draw it accurately. (See

Exercise II. DRAWING FROM AN OBJECT.

OBSERVATIONS FOR STUDENT.

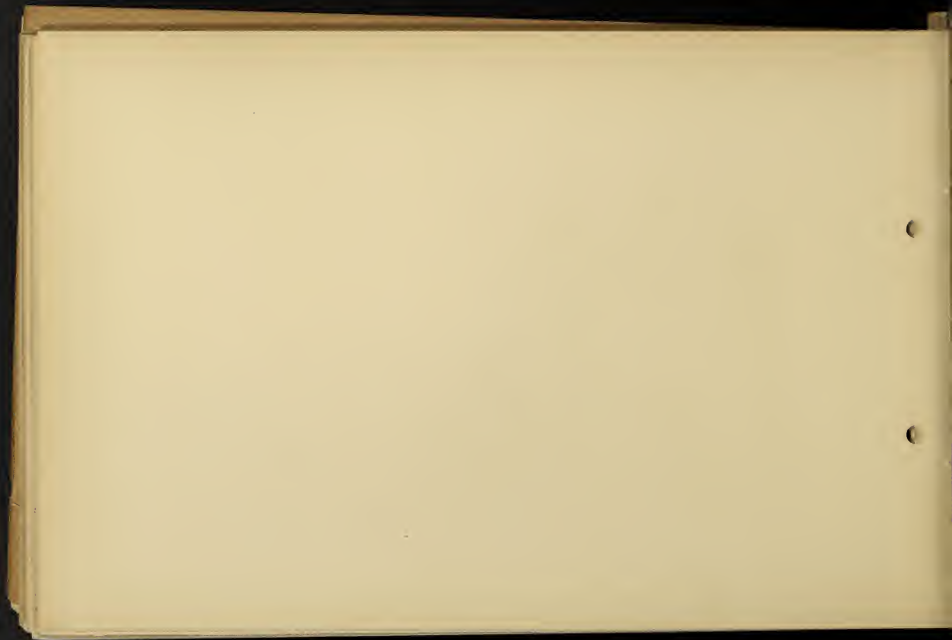
Application of Perpendicular Lines.

DRAWINGS TO THE TEACHER.
Have a red square of paper six lines
up and from your board. Now, five
inches wide for eight inches long.
Width of board and (about) two inches.
Make a drawing from its full size to
size given below.

NOTE: If the height and the
width appear to be too different, the
pully room. Then the perpendicular
square does not know and let us the
pencil mark the line from of these
corner placed close together, side to
side, each standing on a line.







Exercise XXI. DRAWING FROM OBJECTS.

DIRECTIONS TO THE TEACHER. Stand a cube on one angle between two other cubes. Have the pupils study the edges closely, observing proportions. Points where corners of oblique cube touch vertical edge, etc. Which cube be best drawn first, and why? Pupil make a drawing of the front view of the cubes in the second lesson. Make faces about two inches square.





Exercise XXII. REPETITION

When a number of forms or objects alike are placed in a row, it is called a Repetition. Repetitions may be made horizontally, vertically, or obliquely.

DIRECTIONS TO THE TEACHER. By means of lines on page 14, make a series of identical vertical rectangles. Call the attention to the points in the middle of each corner, and the middle of the top and bottom edges. Then make a series of identical parallelograms by repeating, cutting with a ruler and pencil. Call the attention to the points in the middle of each corner, and ask each to make a border like the first one, the last one of the book on page 14.

On this page are given three Greek borders. Teach the pupils to use how they are made.

First. A GREEK BORDER. Repetition of Parallel Lines.

Second. A GREEK BORDER OF PARALLEL SLANTING LINES.

Third. A GREEK BORD. A Border of Perpendicular Lines.

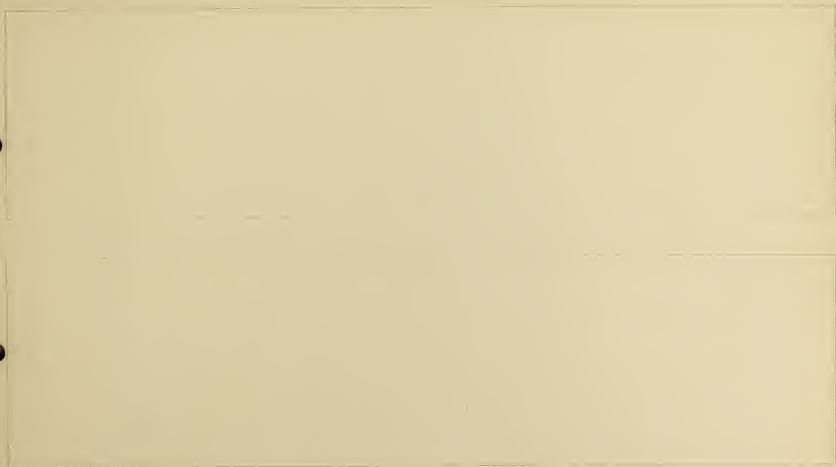
Exercise XXIII.

In the upper corner on page 14. Make a drawing of the second figure given on this page. Place five points one-quarter of an inch from corner of each. By means of a ruler place points gradually one inch apart in a series of five between the upper left point and the corner of the page. Repeat between the lower left points. Draw free hand.

Exercise XXIV

In the lower oblong make a series of lines of various lengths and positions. Draw free hand.

DRAWING OF A BOOK LEADER COMPOSED OF OBLIQUE LINES AND A GREEN PREL



Exercise XXV. ORIGINAL BORDER—*Repetition*

DIRECTIONS TO THE TEACHER. Give each pupil twelve numbered sticks. Ask him to make an Original Border by spreading these sticks in any good manner. When the border has been carefully arranged ask the pupil to place a piece of each stick, running one stick at a time, and move it first in its place. The sticks will go into place and be removed and the border drawn. Boundary lines should then be drawn—*See illustration on page 16.*

Exercise I. REVIEW.—HALF-INCH.

DIRECTIONS. Place points in spaces as shown in first illustration. Draw lines one-half inch from corners; then center points, etc.

Exercise II. REVIEW.—BISECTING.

Exercises to be drawn on blank space in second illustration. Put rings around points to make positions more evident.



1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

17	18	19	20
21	22	23	24
25	26	27	28
29	30	31	32

Exercise III. TRAPEZOID.

Incline into three equal parts.
Use red pencil, or finger and pencil, of various positions for each point or part. First point one-half inch from bottom. Traced as shown in first illustration.

Exercise IV.

For the slates. Draw at bottom and tracing complete. See second illustration.

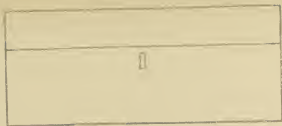
Exercise V. REVIEW OF HORIZONTAL LINES.

Straight, Level Lines are Horizontal.

Draw on slates lines as shown in first illustration. Part of the class draw on boards.

Exercise VI. OBJECT, WITH HORIZONTAL LINES.

Draw a box from the object in the space below, similar to second illustration. Points, one-half inch from corners. Draw horizontal lines from left to right. No erasing in any exercise in this book.





Exercise VII. REVIEW OF VERTICAL LINES.

DIRECTIONS TO THE TEACHER. Review vertical lines from object. Have the pupils draw vertical lines on the blackboard, and test them by means of a "plumb-bob."

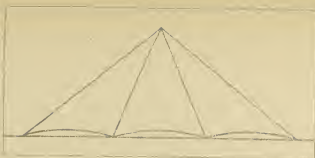
Exercise VIII. APPLICATION OF VERTICAL AND HORIZONTAL LINES IN A GREEK BORDER.

DIRECTIONS. Place points one-half inch from each corner of space below. Bisect the distance between the two upper points; bisect the distance between the two lower points. Trisect each half of the space above and below. Draw all the vertical lines first. No erasing.









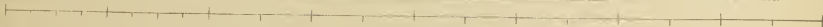
Exercise IX. REVIEW OF OBLIQUE LINES.

Draw on slates and board.

Exercise X. APPLICATION OF OBLIQUE LINES.

An Arab's Tent.

DIRECTIONS TO THE TEACHER. Give directions for the ground. (Points one-half inch above the lower edge of page.) Ask questions as to method of drawing, and position of top, corners, etc. Explain thoroughly, and allow pupils to draw without further assistance.





Exercise XI. REVIEW OF PARALLEL LINES, PERPENDICULAR LINES, AND THE STUDY OF ANGLES

In Book 2 you studied about parallel edges and lines. Can you find any parallel lines on this page? Any perpendicular lines? Any lines near together, and yet neither parallel nor perpendicular? Can you find two lines starting at a point and going in different directions? Can you find two lines starting at a point, and going in nearly the same direction? Going in nearly opposite directions?

The difference in direction of two straight lines meeting at a point is called an angle.

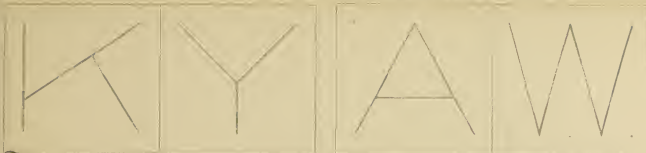
How many angles can you find on this page? Lay angles, using sticks. Draw angles on board and stone, after finding angles in the room.

Exercise XII.

In the space below draw a number of angles, arranging them so that they will look well on the page.

Remember, the size of an angle is not dependent on the length of its sides.

THE DIFFERENT KINDS OF ANGLES.



NOTE: The amount of difference in direction between the two sides of an angle decides its name.

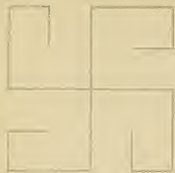
If there is but little difference in direction, so that the lines form a *sharp corner*, the angle is called *Acute*, meaning sharp.

If the lines are perpendicular, that is, form a *square corner*, the angle is called a *Right Angle*. If there is very much difference in direction, so that the lines form a *slant corner*, the angle is called *Obtuse*, meaning blunt.

Exercise XIII. See that the pupils understand the three kinds of angles, and are able to recognize them anywhere. Use sticks or splints.

Exercise XIV. How many acute angles on these two pages? How many right? How many obtuse?

In the spaces below draw the letter having all acute angles and the letter having all kinds of angles.



Exercise XV. APPLICATIONS OF ANGLES IN DESIGNS.
Disposition around a centre.

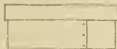
Select one of the above designs and enlarge in space at will. Or arrange one and two-inch sticks so as to make a similar design, and draw that.

Exercise XVI. DRAWING FROM OBJECTS.

A collar-box or berry-box, to be drawn in space below, from the object. Study proportions carefully. Obtain corners first.

Exercise XVII.

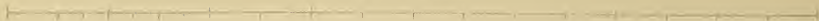
DIRECTION: Cut a game like illustration 1/2 inch, 1/2 inch and three-fourths inches long by four and three-fourths inches wide; width of sides, one inch. (Use pasteboard.) Make a drawing from the object in space at right.



NOTE: Should these exercises prove to be too difficult for the pupil, draw a simple oblong from some object in the space below, and give a simple dictation exercise for the space at the right.

TO BE USED AS THE TEACHER THINKS BEST.

For Review or Examination.



Exercise XVIII. THE CURVED LINE.

DIRECTIONS TO THE TEACHER. Teach from objects, the curved line. When studying edges two kinds of edges are found. What are they?

How is a straight edge represented?

How shall we represent a curved edge?

Derive faces. Square face from a cube, and round face from a cylinder and hemisphere. Here is a picture of the round face of a cylinder. (Draw one on board.)

Pupils select rings to represent faces of different sizes.

Lay rings on paper and trace around them, then practice movement on slate, tracing around and around, as shown in Fig. 1, in the direction indicated by the figures.

Exercise XIX.

Practice movement and drawing again on slate or manilla paper. A picture of a round face in a circle.

Exercise XX.

Trace around the circle, as indicated in the space at the right, beginning at point 1, and passing round and round many times. Draw very lightly, that is, *sketch*.

A part of a circle is called a circular curve.



THE TWO ROUND FACES OF A CYLINDER.

Exercise XXI.

DIRECTIONS TO THE TEACHER. After practising the movement have the pupils draw in the space below, at the left, a picture of one of the round faces of a cylinder. Place points one-half inch from the centre of each side of the space, to indicate the size of the drawing. Draw round and round. Draw a picture of the other round face in the space on the right. Proceed as before. No erasing.

SIMPLE CURVES.

A circular curve is sometimes called an arc.



Exercise XXII.

What is a circular curve?

What are circular curves sometimes called?

Select circular wire curves, place a number together so as to form a circle.

What kind of lines are printed upon this page in the illustration?

Why are they called by the name you gave?

Curves in the position of those on this page are sometimes called vertical curves. Why?

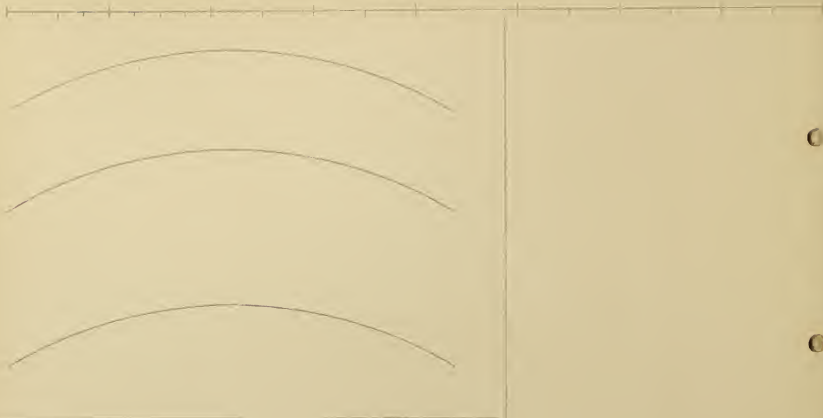
Curved lines should be sketched lightly first, with a free, easy movement of the whole arm; afterward they may be corrected, if necessary, and lined in.

Trisect the distances between the upper ends of the curves given at the right and between their lower ends. Also, if necessary, trisect the distances between the central points of the curves. Sketch and line in other curves, as shown in illustration. Practice drawing circles and circular curves at the blackboard as often as possible. Make the drawings large



SIMPLE CURVES.—Arcs curving upward, and application.

Each arc should be sketched from left to right with one movement of the hand.



Exercise XXIII.

Sketch and line in curves in the space above, as shown in illustration. Place points for three more curves.

Arcs or curves in this position are sometimes called *horizontal curves*. Why?

In the space at the right place a vertical row of points one-half inch apart, beginning one-half inch from the lower left corner. Make a similar row beginning one-half inch from the lower right corner. Connect the points by parallel arcs curving upward, like those in the illustration. Or the pupil may lay white curves so as to fill the space well, then removing one at a time, replace them by



APPLICATION OF ARCS CURVING UPWARD.

Call pupils' attention to the parallel arcs of the arches. Notice that all the longer arcs are on the same level; also all the shorter arcs.



Exercise XXIV. BRIDGE.

Make a drawing of a bridge with boys fishing, as shown in illustration. The guide-lines given above are to be used in determining the height of the arches, their width, etc. The longest horizontal lines may be sketched by use of a ruler, if too difficult to sketch freehand. When all the lines are sketched, lay on, as shown in illustration. If the boys are too difficult for pupils to draw, they may be omitted.

SIMPLE CURVES. Arcs curving toward the right.

These arcs should be sketched from the top downward, with one motion of the whole arm.



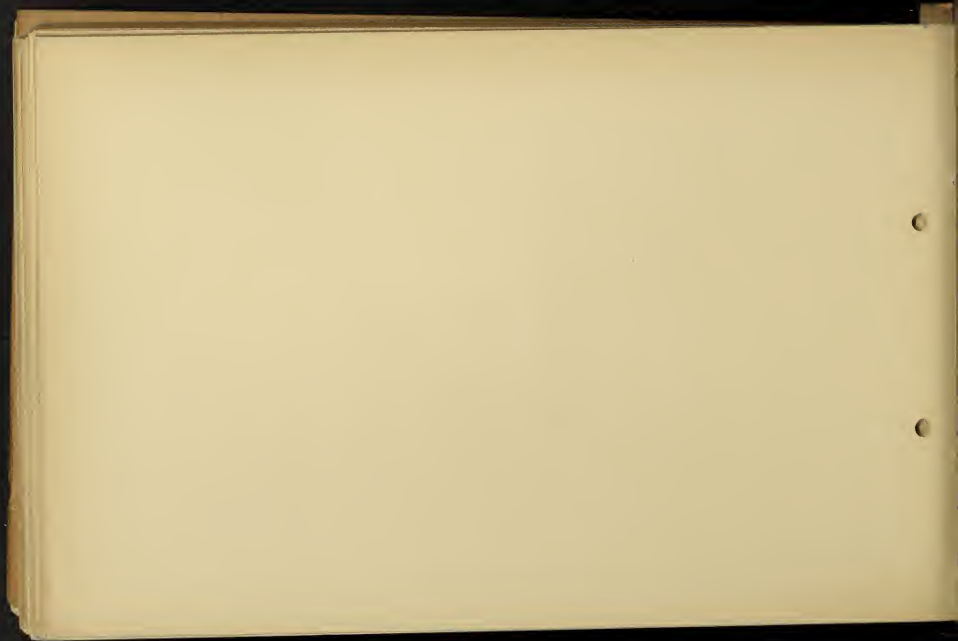
Exercise XXV.

Divide the distance between the upper ends of the curves given at the right into five equal parts. Divide distance between lower ends in same way; also, if necessary, the distance between central points of the curves. Sketch the curves carefully, and line in as shown in illustration. Try to sketch the curves correctly the first time.

Place points at the left of the curves already drawn, to indicate the ends of parallel curves, in such positions as to continue the series across the page. Or use the wire curves.







SIMPLE CURVES.—Arcs Curving Downward, and Application.

17

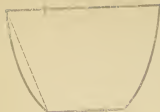
These curves should be sketched from left to right with one movement of the whole arm.



Exercise XXVI.

Divide the distance between the left ends of the arcs given above into five equal parts. Divide distance between right ends of curves in the same way. Also, if necessary, between central points of the curves. Sketch the curves carefully, and line in as shown in illustration. Try to sketch the curves correctly the first time. In the space at the right make a vertical row of points, beginning one-half inch from the upper left corner. Make a similar row on the right side.



**Exercise XXVII.**

From a bowl or cup, similar to that shown in the illustration, make a large drawing in the space at the right.

Have the pupils study the object carefully first, to determine the proportion.

Notes: the comparative width top and bottom. How does the width compare with the height? Notice the angle, the slope of the sides as indicated in the illustration by the dotted lines.

Sketch first, then fill in.

Exercise XXVIII.

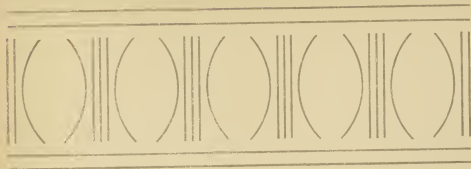
From a cup and saucer make a large drawing (fill page 15, page 16). Study the objects first, and determine the proportion; then sketch and fill in with a bold gray line.

Notes: If this is too difficult, draw the washbasin. This, like the saucer, may be represented by two straight lines and two curves.





ALTERNATION, STRAIGHT AND CURVED LINES IN A BORDER.

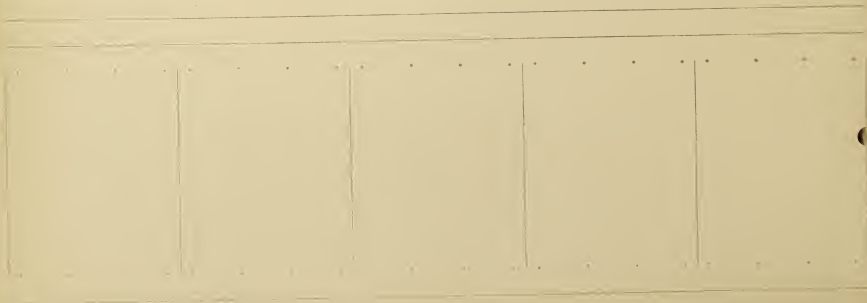


Exercise XXIX.

In Book 1 you studied about Repetition in Design. Can you find an example of Repetition in a straight border in this book? Can you find an example of Repetition around a centre? What is meant by *alternation*? The illustration on this page is an example of *Alternation*. Find an example of *Alternation* in the room.

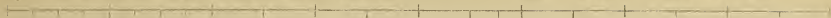
Exercise XXX.

Enlarge the illustration to fill the space below as indicated, or make a new design, using sticks and wires.



SKETCHED LINES AND DRAWN LINES.

NOTE. In *sketching* a line, hold the pencil not less than one inch from the point; in *sketching* a line, two or three inches from the point.



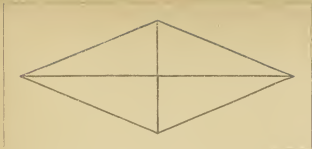
Exercise I.

Place points for oblique lines one-half inch from corners of first space at the right. Complete, as shown in illustration.

Exercise II.

Place points as in Exercise I, and complete, *sketching* the line, instead of *drawing* them.



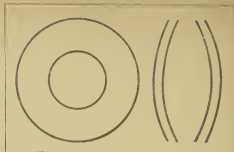


Exercise III. APPLICATION OF ALL THE ANGLES.

From object. Cut the diamond from paper. Size, three and one-half inches wide by eight inches long. Make a drawing from it in space below. Question pupils as to angles.

Exercise IV. REVIEW OF CURVED LINES.

Upon the left side of page 3, pupils draw a circle as large as the space will allow. Practice movement first. Draw the curves at the right.



REVIEW OF CURVED LINES.





Exercise V. TRIANGLE.

A plane figure has *three sides and three angles*.

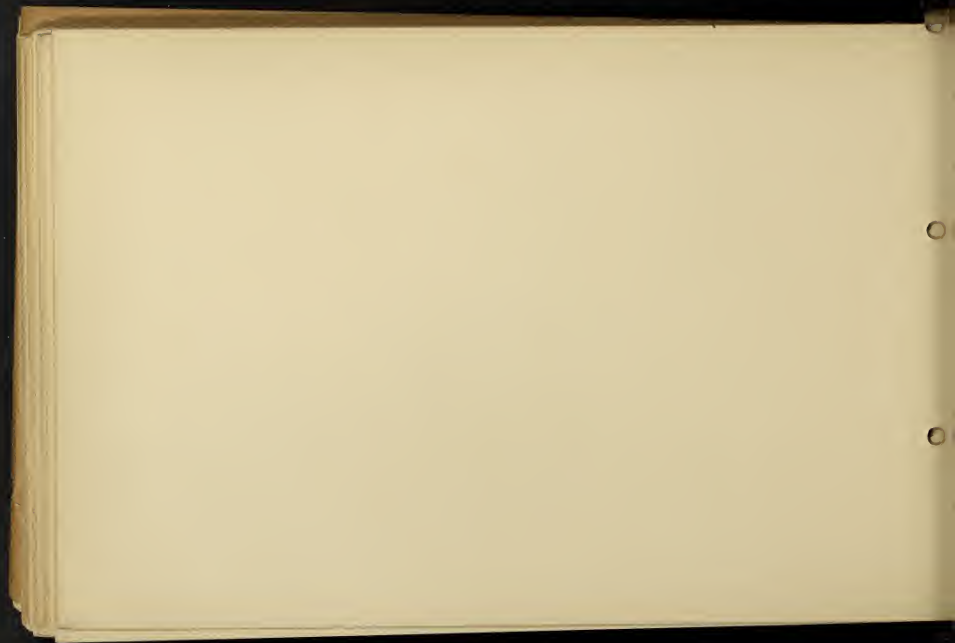
DIRECTIONS TO THE TEACHER: Cut a large number of triangles of different shapes and sizes from paper or cardboard; draw others upon the board. Pass these teach triangles to the pupils. Lead them to discover for themselves the number and kind of sides, the number of angles, etc. Have them cut triangles of paper and draw them on board.

Exercise VI.

In the space below ask pupils to draw three triangles of such size as to fill the space well; but no triangle to be exactly similar to any given in the illustrations.







Exercise VII. RIGHT-ANGLED TRIANGLE.

Triangles are divided into six classes, according to their characteristics. A right-angled triangle is a triangle having one right angle. Cut right-angled triangles from paper, of different sizes and proportions. Study from objects. On the left half of the space below draw from paper a right-angled triangle, similar to that shown in illustration. Draw large. Points, one-half inch from corners.

Measure the size of your drawing, and cut a triangle like the drawing from colored paper, and paste it in the proper position upon the page. See illustration.



APPLICATION OF RIGHT-ANGLED TRIANGLES.

EXAMPLE VIII.

In the space at the right exhibit the *drawing* of the corner to be cut, shown in the illustration (the numbers having for 1 unit a breadth like this, and lines 5 being understood the distance).

EXERCISE IX.

Construct the *framed* part of the *heavy* lines, *representing* the *form* to be cut. Make *curves* through it by the *vertical* line, *from* edge *a* to *b*. The *rule* may *cut* *quite* the *two* thick *masses* for *this*, and *then* put *by* *striking* *thin* *permanents* *shape*, of the *new* *part* the *pattern* in the *space* *below*, *having* that *part* *above* the *horizontal*, and *that* *in* the *left* of the *vertical* *apex* *extended*, so that the *form* may be *easily* *folded* into *shape* and *be* *used* for *parts*.



THE ISOSCELES TRIANGLE.

The line upon which a triangle seems to rest or stand is called its *base*. The vertical distance from this line to the highest point of the triangle is called its *altitude*.

Isosceles means equal-legged; *i.e.*, having two legs or sides alike.

Exercise X.

Study isosceles triangle first from objects.

When thoroughly understood, ask pupils to cut from colored paper an isosceles triangle $3\frac{1}{2}$ inches by $4\frac{1}{2}$ inches, and bring it for the next lesson.

Exercise XI.

Paste the triangle upon the left side of the page, and make a drawing of it upon the right.



ISOSCELES TRIANGLE AND APPLICATION.

Isosceles means equal-legged, *i. e.*, having two legs or sides alike.



Exercise XII.

Place points one-half inch from lower corners of first space at the right. Draw the horizontal line. Sketch the vertical line and quadrisection it. Complete, as shown in illustration.

Exercise XIII.

In the second space at the right, place points and sketch the guide-lines, as shown in illustration. Draw the brush-drawn form from the object.



MEMORY DRAWING AND DICTATION.

In the left-hand space below make a memory drawing of Exercise XI. In the right-hand space make a drawing from a simple dictation given by the teacher.

Exercise XIV.

Exercise XV

EQUILATERAL TRIANGLE. For Definition, see second page of cover.

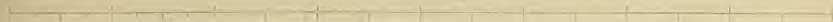
Equilateral means equal sides.



APPROXIMATIONS OF THE EQUILATERAL TRIANGLE

21

Obtain objects inclinations (draw two isosceles if possible, and draw from them.)



END OF ARCHITECT'S SCALE



Exercise XXIII.

Complete the drawing of the end of an architect's scale for the space shown, using the guidelines, as shown in the small illustration.



Exercise XXIV.

Place your compasses half an inch upon the line, and put the circle for each of four lines, and draw in the triangular corners with the pencil (diamonds); with these lines for guides draw the formation, as shown in the trapezoid. Or, the first figure of the formation in Exercise XXIII, and draw the trapezoid the width of a side, and parallel the lines of the side.

DRAWING FROM THE OBJECT

These illustrations represent suitable objects from which to make drawings. Drawings of these objects are recommended for this page.



Exercises XX and XXI.

In making drawing from an object, and the object carefully to be drawn, draw its whole height and breadth with a compass. Then draw the proportion of the object, and the aspect of surface to be raised by the drawing, and draw by light lines the width and height. Another drawing, and draw upon the same surface, and draw next, the proportion of the parts of the object to one another, etc. Make drawings in 60 seconds given.



How to Study the Square.

Direct from the Teacher.

From cubes of various size.

From tiles, bases, and pasteboard

squares, teach the square. Lead

the pupils to see that it is

bounded by four equal straight

sides, and that it has four right

angles. Ask each pupil to cut

a piece of paper four inches on

each side. Fold the square so that

one side will cover the opposite

side. Fold for another crease at right

angles to this. Notice

where the creases cross each other, and how they divide the square.

These creases form the *diameters* of the square. Fold one corner

over to the opposite corner. Fold again at right angles to this,

e. g., through the other corners. Notice how these creases divide

the square. These form the *diagonals* of the square. A square

has two diameters and two diagonals. Question pupils closely as

to the possibility of drawing other diameters and diagonals in a

square. Be sure that they all understand that the diagonal is not

necessarily an *oblique* line, but that it may be otherwise according

to the position of the square.

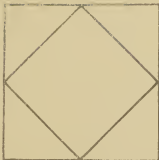
Exercise XXII.

Place points one-half inch from corners of space at right. Con-

nect points so as to form a square. Bisect each side of square,

and draw inner square, as shown in illustration. Draw the

diameters of the larger square.





Exercise XXIII. A GREEK CROSS.

Place points about one-half inch from corners of space below. Sketch the square, and draw each side. Sketch lines through the square, connecting opposite points. Give up, as shown in illustration.



Exercise XXIV. SQUARE WITH DIAGONALS AND DIAGONALS.

Place points about one-half inch from corners of space below. The square is to be drawn with the corners marked with dots. The diagonals are to be drawn through the square, connecting opposite points. Give up, as shown in illustration. The square is to be drawn with the corners marked with dots. The diagonals are to be drawn through the square, connecting opposite points. Give up, as shown in illustration.



Exercise XVI. FOUR-POINTED STAR IN A SQUARE.

Let a given line AB (solid) represent the length of the square, and let CD (dashed) represent the length of the star. The given square is to be divided into four congruent triangles, and the star is to be constructed by the method of the given line AB (solid) and the line CD (dashed).



Exercise XVII. SQUARE.

Let a given line AB (solid) represent the length of the square, and let CD (dashed) represent the length of the star. The given square is to be divided into four congruent triangles, and the star is to be constructed by the method of the given line AB (solid) and the line CD (dashed).

REVIEW OF REPETITION.

Exercise XXVII. BORDER OF TRIANGLES. A Vertical Repetition.

DIRECTIONS. Divide lines given in space at right, as shown in illustration. Draw all the horizontal lines, and bisect. Complete as shown.

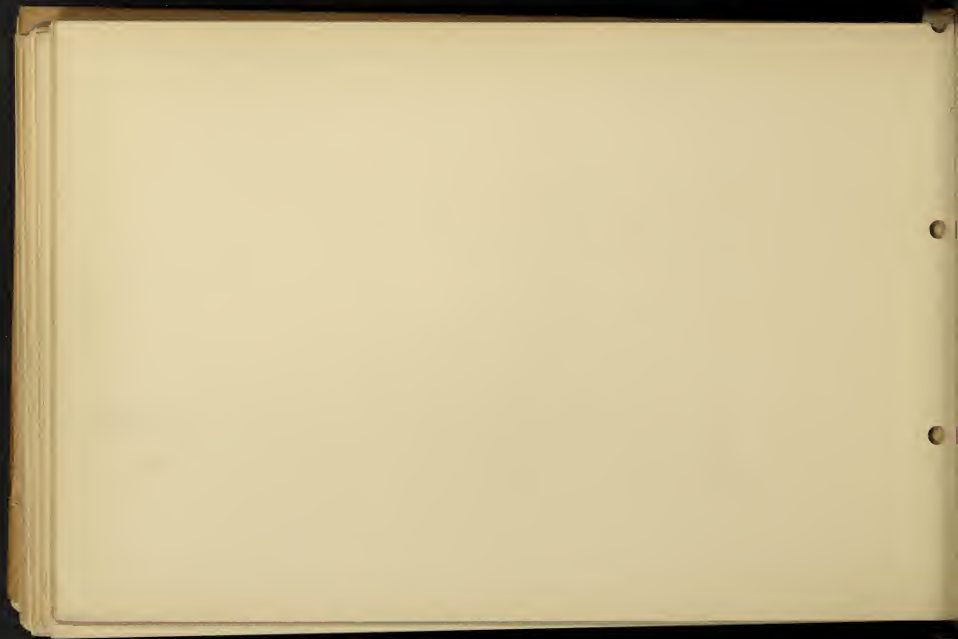
Exercise XXVIII. AN ORIGINAL BORDER.

DIRECTIONS. Ask the pupils to cut from paper eight isosceles triangles, having a base of one and one-half inches and an altitude of five-eighths of an inch. Cut the triangles all of one color of paper. Bring these and arrange them in the space below so as to form a border. Be particularly careful about the spacing. About two-thirds of the surface of the border should be covered by the units.

When the border is pasted in the book, cut two strips of paper about one-quarter inch wide and five inches long. Paste these above and below the border to form enclosing lines. See next page.



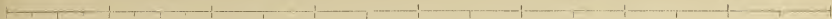




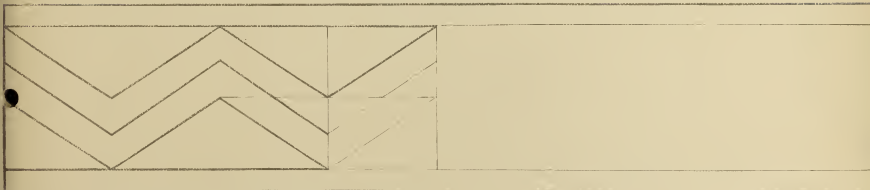
APPLICATIONS OF TRIANGLES IN BORDERS.

17

The first is the Egyptian Zigzag; supposed to represent the water in the Nile. The second a border of overlapping triangles.

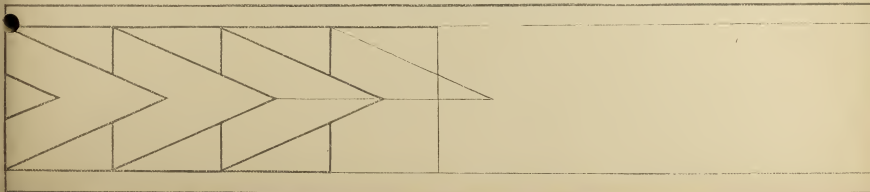


EGYPTIAN ZIGZAG.



Exercise XXIX. Sketch guide-lines first ; draw central zigzag lines last.

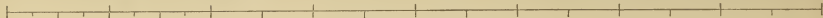
REPETITION OF TRIANGLES, OVERLAPPING.



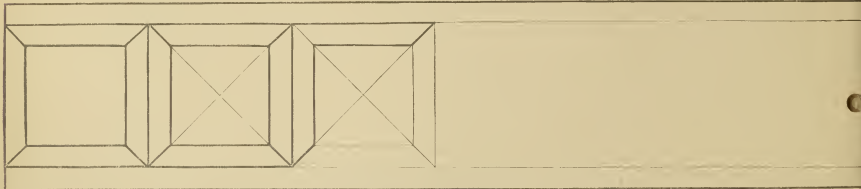
Exercise XXX. Sketch guide-lines first ; sketch each triangle complete ; line in, as shown in illustration.

APPLICATIONS OF SQUARES IN BORDERS.—Repetition.

NOTE. A row of forms or objects alike is called a repetition; but the repetition may be in a straight line, as in the borders on this page, or around a central figure, as on the next page.



A BORDER.—To be completed.

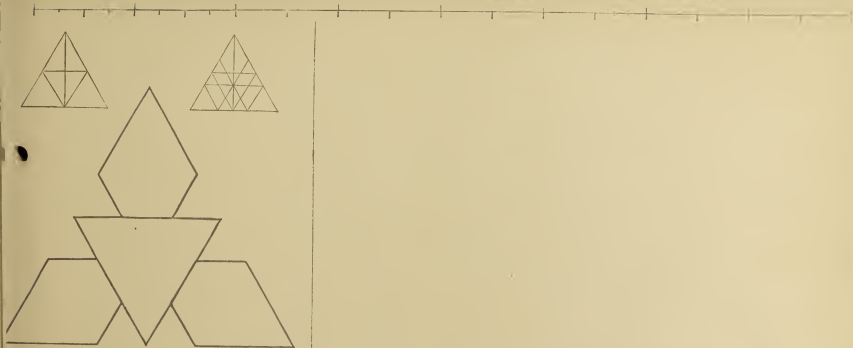


Exercise XXXI. Divide the remaining space into squares, sketch the guide-lines and complete, as shown in illustration.

AN ORIGINAL BORDER WITH SQUARES.

Exercise XXXII. Cut squares of paper, size one inch, and arrange in an original repetition. Trace the squares, and line in carefully with a hard pencil.

Note the central triangle. This appears to hold the other parts of units in place, and gives strength to the design.



Exercise XXXIII.

NOTE. A design in which units are placed around a center called a Radial Design.

Place points one-half inch from lower corners of space at ht. Sketch a horizontal line, connecting them. With this e as base sketch an equilateral triangle. Complete the ewing in the order indicated by the small illustrations near of page. Line in, as shown in large illustration.

The design may be constructed of colored paper, and ted on page 20. Units: three diamonds and a triangle.

TO BE USED AS THE TEACHER THINKS BEST.



SKETCHED LINES AND DRAWN LINES.—GUIDE LINES.

1

Guide lines are lines which assist in determining the positions and proportions of parts, but are no part of the figure itself.
In sketching them, hold pencil three inches from point.

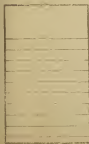


Exercise I.

Place pencil vertically with the point of the pencil on the left. Sketch the diamond, and the diagonals and lines in as shown in illustration.

Exercise II.

Place pencil one-half inch to the right of second line on the right. Draw from where the pencil is, as shown in illustration. Light lines are to be drawn.



**Exercise III.**

Review triangles. Pupils draw on board from pasteboard triangles, similar to those shown in illustration.

Exercise IV. BRACKET.

Cut the bracket, as shown in illustration, from wood or pasteboard. Length of short sides of shelf before the corner is cut away, five inches. Bracket, three inches wide and five and one-half inches long. Make drawings from these in space at the right. Study curves carefully. Draw shelf first, full size. May be constructed at home.

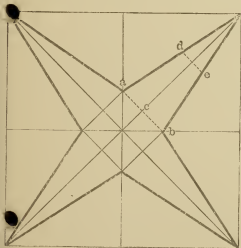


REVIEW OF ISOSCELES TRIANGLE, AND
APPLICATION.

Exercise V. Pattern of a square hanging basket. In the space right make a drawing of the pattern of the basket.

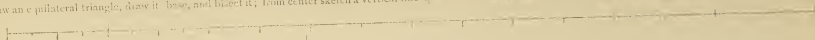
DIRECTIONS TO THE TEACHER.—Cut a square of thick paper, if possible colored on one side, so that a four-pointed star, like that represented, shall be made. Fold each ray of the star on line corresponding with *a b*, and double the point back to touch *c*—thus making a crease *d e*. From this pattern the pupils make the drawing.

Exercise VI. The basket may be constructed by folding and stitching the pattern, and adding threads, as shown in illustration.



REVIEW—EQUILATERAL TRIANGLE AND APPLICATION. For definition, see second page of book.

To draw an equilateral triangle, draw its base, and bisect it; from center sketch a vertical line upward. From the end of the base-line, set off its length upon the vertical line, and complete.



Exercise VII.

Draw an equilateral triangle in the space above. Connect points given, to form the base. Give the same size of paper and paste over the drawing.

Exercise VIII. A SIX-POINTED STAR.

Place points one and one-half inches from lower edge of space at the right, and one inch from the sides. Connect points for a

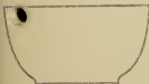
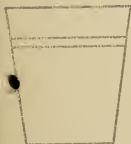




DRAWING FROM OBJECTS.

5

Or to be used as the teacher thinks best.

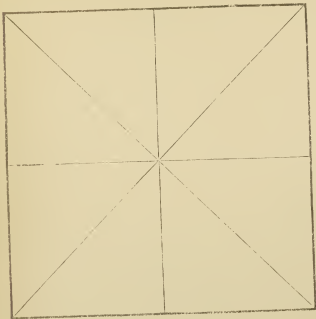


Exercise IX.

Make a drawing from one or more objects on this page. The illustrations are given to suggest suitable objects and to show the kind of drawing required.

THE SQUARE. Diameters and Diagonals. For definitions, see second page of cover.

Diameters and diagonals will be best understood by folding paper squares to obtain them.



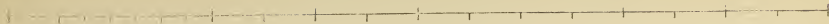
Exercise X.

Place points one-half inch from corners of space at the right. Sketch this square. Bisect its four sides, and sketch the diameters. Sketch the diagonals. Line in the square. A square may be in such a position that all its sides will be oblique lines. Trisect each semi-diagonal and connect the outer points, so as to form a square concentric with this.

Can you fold a four and one-half inch paper square in such a way that, by making one cut, a central smaller square will be removed, leaving a square frame of paper, like that represented by your drawing? Try it.

THE SQUARE.—APPLICATIONS.

Dictation and square frame of paper.



Exercise XI. DICTATION.

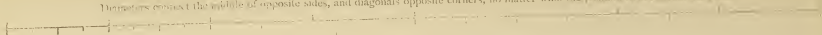
Place points one-half inch from corners of space above. Sketch a square with these points as corners. Sketch its diagonals and bisect each semi-diagonal. Line in the outer quarters of each diagonal. Line in the top and bottom of the square. Draw a small square, using the points on the semi-diagonals as corners. Result—a spool.

Exercise XII.

Make a square frame of paper, as suggested on page 6, and paste

SQUARE AND ITS DIAGONALS AND APPLICATIONS.

Diameters connect the middle of opposite sides, and diagonals opposite corners, no matter what the position of the square may be.



Exercise XIII.

Cut a square of paper—accurately three inches on a side. Upon one side draw accurately the necessary lines, so that a Maltese cross like that shown in the illustration may be made. Cut out the cross and paste it in the space above.



Exercise XIV. MALTESE CROSS.

Make a drawing of your cross in space at right. First points one-

SQUARE AND ITS DIAMETERS. AND APPLICATION.

Pattern of a Hanging-Basket.



Exercise XV.

DIRECTIONS.—Cut a square from paper, five inches on a side. Fold for diameters. Fold corners to center, and cut off one corner on the crease thus made. Cut from one end of the oblique side to the center of the square. Fold a to b , and turn the corners

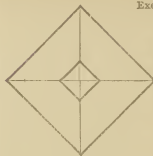
down. Result—a triangular basket. Draw the pattern in the space at the right. Begin with the center point. Pupils construct as shown in the illustration. Points shown in pattern show positions of holes for the string to suspend the basket.

NOTE: The basket may be ornamented in various ways. One effective way is to modify the corners. Each corner is, of course, a half square. These half squares may be cut like any of those shown on page 18.

If the corners are thus modified, have the four corners alike.

SQUARE ON ITS DIAGONALS, AND APPLICATION.

Exercise XVI. DICTATION.



Sketch figure 16 on the left half of page 11. Draw an ornamental square. Divide its sides. Trisect sides of outer square. Draw tangents to circles from points on outer square to nearest points on inner square. Line is the outer rhombus of the sides of the large square. Result—a Radial Design.



Exercise XVII. A QUARTERFOIL.

(For definition, see cover.)

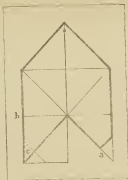
Enlarge the illustration to fill the space at the left. Draw construction lines first—carefully—cut a quarterfoil from paper and paste in left half page 11.

APPLICATIONS OF SQUARE ON ITS DIAGONALS.

For wall-pocket, cut an oblong from paper, size five by seven and one-half inches, and fold to obtain the light oblique lines shown in illustration. Cut as shown by heavy lines.

Exercise XVIII.

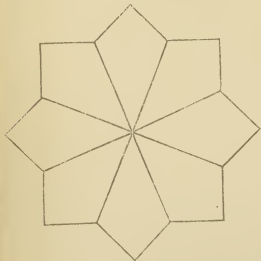
In space at the right make a drawing from the pattern of the wall-pocket. Begin in center. To construct the pocket, cut the pattern from paper, as indicated by the heavy lines (light lines indicate creases). Bring point *a* to *b*, and fold over *c* over the short oblique edge near *d*, to form the pocket.



CONCENTRIC SQUARES AND APPLICATION.

Squares are called concentric when the center of one is directly over the center of the other.

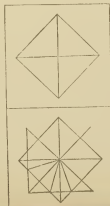
Cut two squares from paper, and fasten together by a pin through their centers. These will be concentric, regardless of size or relative position of sides.



Exercise XIX

Sketch a square on its diagonals in space at right. Proceed as shown in small illustrations. Erase all construction lines, and line in as shown in large illustration. Would the figure look better with a center? If you think it would, what kind of a center would you add? How large?

If you think best add a center in your drawing.



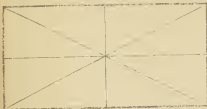
MEMORY-DRAWING AND DICTATION.

Exercise XX. In left-hand space below, make a memory-drawing of some previous exercise.

Exercise XXI. In right-hand space below, make a drawing from a dictation given by the teacher.

THE OBLONG. Diameters and Diagonals.

Oblongs have the same number of lines as squares. Some parts have similar names. For definition see cover.



Exercise XXI.

Study oblong from objects. Pupils discover and describe side angles, etc. Ask each pupil to cut an oblong from paper, size, three by six inches, and fold for diameters and diagonals. The diagonals will be found difficult to obtain in this manner.

Exercise XXIII.

Cut an oblong from colored paper, one and three-quarters by three and a half inches. Fold accurately for diameter and diagonals. (This may be done at home.) Paste the oblong thus folded in the left-hand space below. In large space below, place point in center. Sketch diameters for an oblong, filling the space as usual. Place points for corners and draw the oblong. Sketch its diagonals.

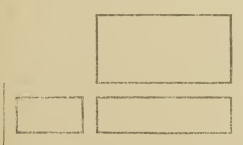


Exercise XXIV.

Have pupils study the shapes of the faces of a brick. Measure them. Find their proportions.

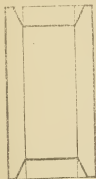
In the lower left corner of the page are two points. Connect these by a vertical line. This line represents one short edge of an end face of a brick.

Draw the other edges in proper proportion. Draw three faces, as shown in illustration. Have the drawings the proper size to correspond with the drawing of the end face.



APPLICATIONS OF THE OBLONG.

REEL.



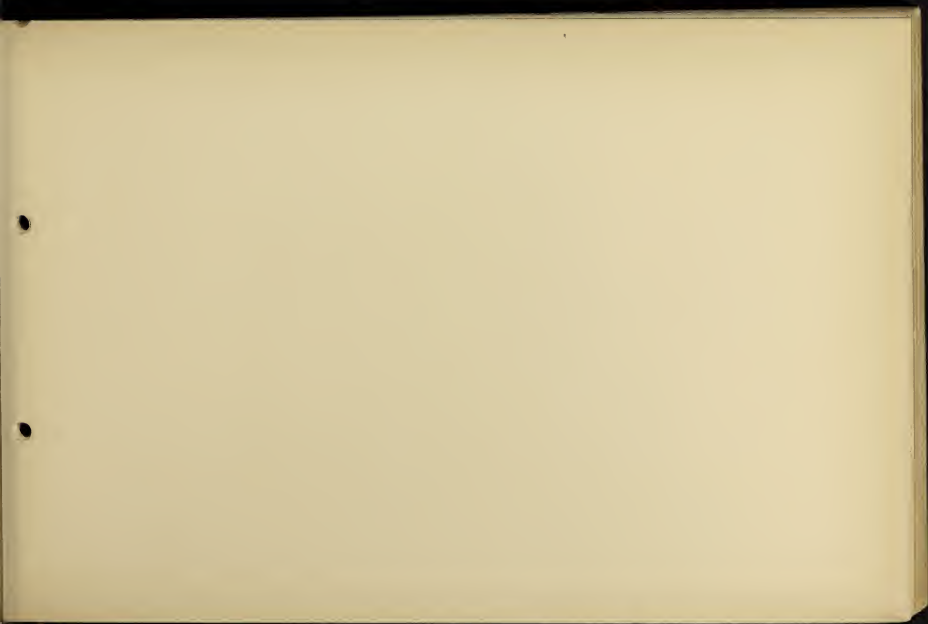
Exercise XXV.

To be constructed by the pupil.

Cut the reel from pasteboard two and one-quarter inches by four and one-quarter inches, as shown in illustration. Make a drawing from it in first space at the right. Guide-lines one-half inch from the sides of the oblong.

Exercise XXVI.

In the second space at the right make a drawing of a prettier shaped reel of your own design. Can you not improve upon the first reel drawn by adding curves here and there? Be careful to add only such curves as will increase the beauty of the object without interfering with its use.

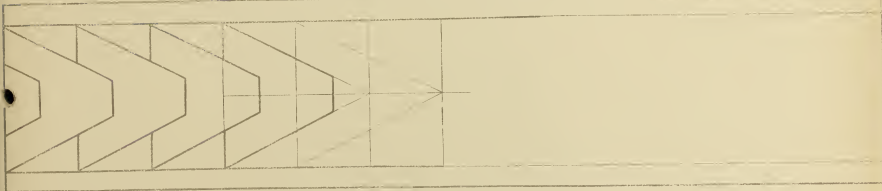




APPLICATIONS OF TRIANGLES IN BORDERS.—Repetition.

The units in both borders are examples of modified geometric forms. Both are Isosceles Triangles, one with the point removed, the other with its base notched.

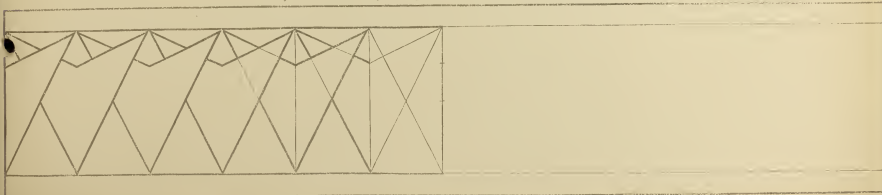
BORDER OF OVERLAPPING TRIANGULAR FORMS.—To be Completed.



Exercise XXVII. Sketch guide-lines ; sketch triangles complete ; line in oblique lines first.

BORDER OF ISOSCELES TRIANGLES.—To be Completed.

This border may be constructed by cutting the units of colored paper and pasting on a card

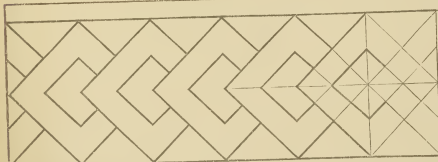


Exercise XXVIII. Sketch guide-lines ; sketch long oblique lines ; sketch other oblique lines ; line in long oblique lines first.

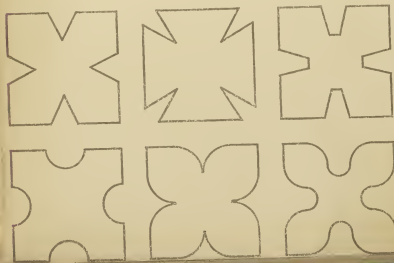
BORDERS WITH SQUARES MODIFIED.—Repetition.

Units are said to be modified when their outlines are made more complicated without destroying the general shape of the unit.

Border of Modified Squares.—To be completed.



Exercise XXIX. Study border carefully; sketch guide-lines; sketch squares; line in left half of each square first.



Notice how the triangles in the borders on page 17 are modified. On this page are given numerous examples of modified units. Some have their sides modified, others their corners. Some are modified by adding straight lines, others by adding curves.

Which of these forms do you consider to be the most beautiful?

Exercise XXX.

Sketch two or three squares on manilla paper or the slate, and modify them.

Make a drawing of your best unit in the space at the right.

Exercise XXXI. Cut a number of squares from manilla paper, and fold one-quarter each on a side, and modify each according to your drawing on the previous page. In space arrange the modified squares for a border, and trace line in carefully.

ORIGINAL DRAWING WITH MODIFIED SQUARES.—Constructed.

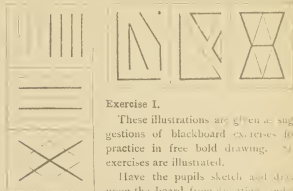
Exercise XXXII. Arrange the modified squares for a border. Or, better, make others from some pretty colored paper, and paste them neatly in the space above. Cut two long strips of the same color and paste them in position indicated by the light lines. Thus construct a border like your drawing.

FOR EXAMINATION OR REVIEW.

To be used as the teacher thinks best.

PRACTICE PAGE.

Review of Light and Dark Lines, Sketching and Drawing.



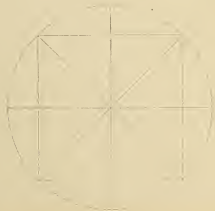
Exercise I.

These illustrations are given as suggestions of blackboard exercises for practice in free bold drawing. The exercises are illustrated.

Have the pupils sketch and draw upon the board from observation, and in unison, one or two of these exercises.

Exercise II.

In the space at the left draw the figure given below. Place points first, then sketch each line once. No erasing.



REVIEW. Square on its Diameters, with Diagonals.

Exercise III.

Place point in center of space. Sketch horizontal diameter extended to within one-half inch of each side. Complete as shown in illustration.

In the space at the right enlarge the illustration given above. Begin with the central point as before.



REVIEW. Square on its Diagonals, with Diameters

Exercise IV.

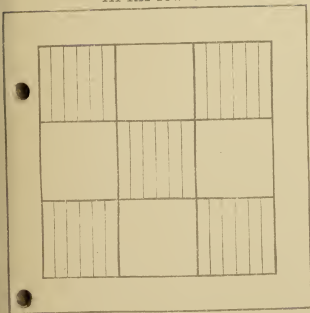
What will be the size of a paper square whose corners will touch the ends of the diameter in your drawing in the last? Cut a square of the proper size to meet these conditions, and paste over your drawing. Cut square to fit in the drawing the same way. Paste it in position.



APPLICATION OF SQUARES.—From the Object.

Construct from board or pasteboard. Size, six inches square. The outside square in the illustration represents the edge of the board—not the space in which to make the drawing.

"TIT-TAT-TOW" BOARD.



Exercise V.

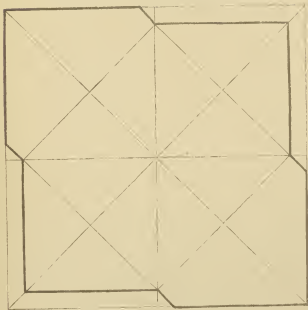
To be constructed by the pupils from the drawing.

Place points one-half inch from corners of space at the right. Draw the outside square, using these for the corners. Draw the inside square. Points one-half inch from corners of larger square. Trisect its four sides, and draw lines to form the small squares. Complete as shown in illustration.

APPLICATION OF THE SQUARE.—An Envelope.

Cut a six-inch square from paper and divide it as shown by heavy lines in illustration. Fold upper right and lower left corners over midlines first; then fold edges. Result, an envelope about four inches square.

PATTERN FOR A SQUARE ENVELOPE.



Exercise VI.

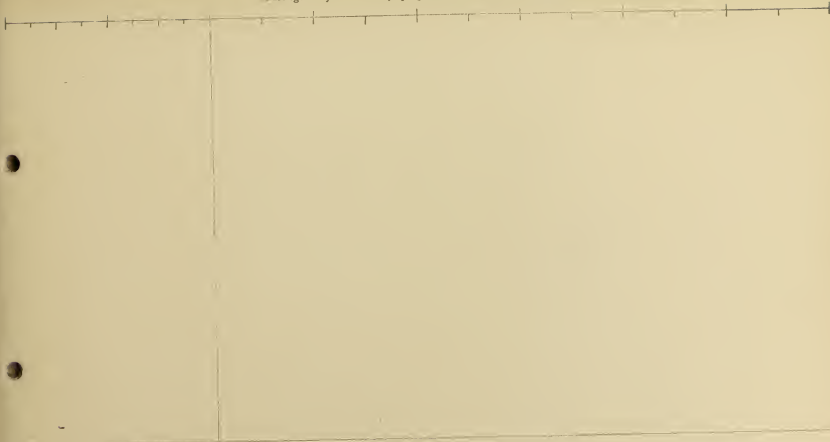
Place points one-half inch from corners of space at the right. Sketch the square. Sketch its diameters and diagonals. Place points one-quarter inch from each end of each diameter. Complete as shown in illustration. Pupils to construct an envelope from their drawings.



5

REVIEW OF THE OBLONG, AND APPLICATION.

Oblongs may be of any proportions and in any position.



Exercise VII.

Cut an oblong from paper—size, two inches by three and one-half inches—and fold so as to obtain lines shown in the smaller illustration. Paste this in the left-hand space above.

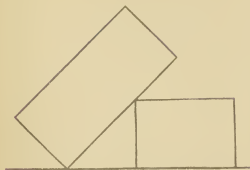
Exercise VIII.

Draw from an oblong envelope similar to that shown in illustration. Study object carefully before beginning the drawing. Place rulers for the corners as usual. Be careful to draw the lines near the corners.



DRAWINGS FROM OBJECTS BASED UPON THE OBLONG.

Place two boxes in the positions indicated in the illustration. Draw from them.



Exercise IX.

Two Oblong Boxes, one leaning against the other.

Sketch the box lying down first. Next sketch the lower side of the oblique box. Be careful to get the angle right, and the length of the side correct. Complete. Especial care should be given to the angles of the oblique box.

NOTE.—Two books might be used instead of the boxes, if the boxes are not at hand.

Exercise X. DICTATION.

Place points one-half inch from corners of space on the left half of page 7. With these points as corners, sketch an oblong. Trisect the horizontal sides, and sketch vertical lines between opposite points. Quadrisect the vertical sides, and sketch a horizontal line between upper points of quadrisecution. Sketch a horizontal line between middle points of quadrisecution. Line in the outline of a Latin Cross.

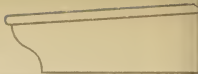
Just in the space at the right

Exercise XI. PRESERVE JAR.

From the Object.

DRAWING FROM AN OBJECT

Exercise XII. In the space below make a large drawing of the end of your desk. Or, if the end of your desk is of iron, make a drawing of the shape of the end (see illustration).



THE RHOMBUS.

A rhombus has four equal sides like a square, but not four right angles. Parts of the rhombus similar to parts of the square, have similar names.



Exercise XIII. RHOMBUS AND ITS DIAGONALS.

Place point in center of space above.
Sketch the diagonals to within one-half inch.

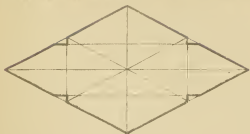
Exercise XIV. DICTATION.

Place points one-half inch from each corner of space above. Quadrant at top and bottom. Line in last three quarters at top, and first three quarters at bottom. Connect ends of lines so as to form a rhombus.



APPLICATION OF RHOMBUS.—Oblong Envelope.

Construct an envelope, as shown in illustration; size before folded, six inches on a side; cut out notches by sides as shown; fold over ends first.

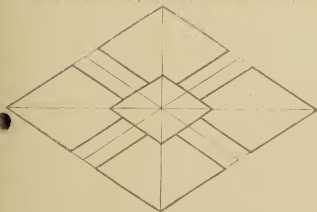


Exercise XV.

Make a drawing on this page, from the pattern of the envelope. Sketch its diagonals first, to within one-half inch of edges of space. Sketch the rhombus. Sketch its diagonals. Connect ends of diagonals by vertical lines. Set off one-half inch from each of each vertex line. Complete as shown in illustration.

APPLICATION OF RHOMBUS IN DESIGN.—Symmetry.

When a figure may be divided into two equal and similar parts by a line through its center, it is said to be symmetrical. The line is called its axis of symmetry.



Exercise XVI.

Place points one-half inch from middle of each side of space. Sketch the diagonals. Sketch the rhombus. Sketch its diameters. Divide diagonals to obtain points for central rhombus. Quadrisection its sides, and from these points sketch lines parallel to diameters, as indicated. Complete.

Would this figure be any more pleasing if all the rhombi were the same size?

Could you make rhombi of one proper size stronger than the present ones? If so, indicate another more pleasing arrangement on the page as your new drawing.

DRAWING FROM OBJECTS.

Exercise XVII. CUP AND SAUCER.



Make a drawing from the object in
all the space below.

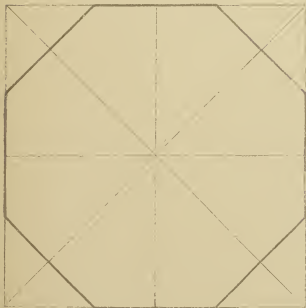
Study construction carefully. Make the curves of one side like the curves of the other, to
make the figure symmetrical.

If you think best, draw from a cup having a handle instead of one like that in the illustration.

THE OCTAGON.—On Its Diameters.

24

For definition, see second page of cover. Cut an octagon from paper, and fold for diameters and diagonals.



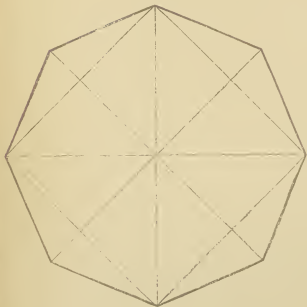
Exercise XVIII

Place points one-half inch from corners of space at the right. Sketch the square. Sketch its diagonals. From each corner of the square set off the length of a semi-diagonal upon each side of the square. Connect the points so as to form the octagon. Sketch the diameters of the octagon. Line in as shown in illustration. Add a concentric circle having a diameter equal to one-half the diameter of the octagon.

Can you fold a sheet of paper in such a way that by making one cut with the scissors an octagon will be formed? Try it.

THE OCTAGON.—On its Diagonals.

The octagon on its diameters was drawn in a square; this octagon outside of two concentric squares.



Exercise XIX.

Place points one-half inch from the middle of each side of space to the right. Sketch the vertical and horizontal lines for the diagonals of the first square. Sketch the square on its diagonals. Bisect each side. Sketch its diameters. Extend each semi-diameter beyond the sides of the square to the length of a semi-diagonal of the square. Draw the octagon as shown in illustration. Add a concentric octagon having diagonals three-quarters of an inch shorter each end.

Can you fold a sheet of paper in such a way that by making two straight cuts with the scissors an octagonal frame will be made?

APPLICATION OF THE OCTAGON.—Silk-Reel.

Pupils to construct the silk-reel from their drawings, using pasteboard or wood; each three inches in length of a diagonal.



Exercise XX.

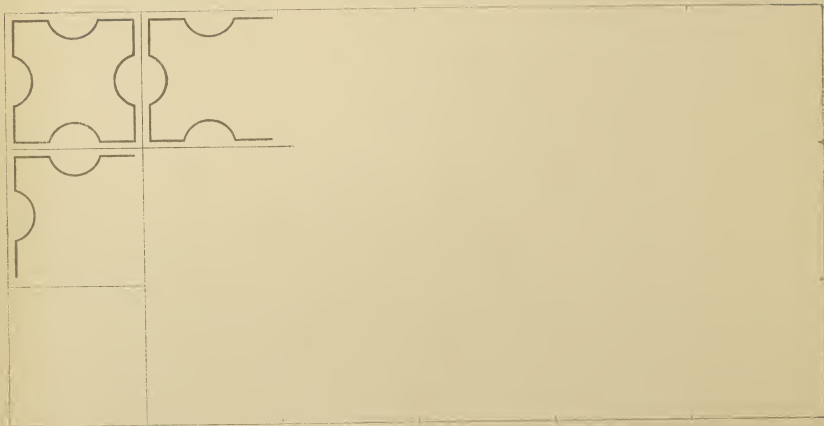
In space above, sketch the construction-lines for the reel and complete as shown in the illustrations.

Exercise XXI.

In space at the right, sketch the construction-lines, full size, for each diagonal three inches long. Begin in center. Instead of completing the reel as before, modify its outline according to your own idea, keeping only the same number of points. A circle or other ornamental shape may be cut from the interior of the reel.

REPETITION OVER A SURFACE.

A design in which the unit may be repeated in any direction, over an indefinite surface, is called a Surface Pattern.



Exercise XXII. Complete the design given above. Use a rule for obtaining construction lines. Line in with a line like the printed unit.

UNIT IN THE SQUARE AT THE RIGHT



REPETITION OVER A SURFACE.

17

Units.



Exercise XXIII.

In the space at the left are given a number of modified geometric forms suitable to be used as units. Which of these do you consider to be the best unit? Why? Which do you consider next best? In the left-hand space below make a careful enlarged copy of one of the units.

Exercise XXIV.

In the right-hand space make a careful enlarged copy of another unit given in the illustration.

REPETITION OVER A SURFACE.

Original Units.



Exercise XXV.—In the space above sketch (and original size) modified squares—one a unit to be repeated in a field like Fig. 1, the other to be repeated in a field like Fig. 2. Sketch them as large as the space will allow.

Exercise XXVI.—Which kind of a field do you prefer to use—Fig. 1 or Fig. 2? Using a ruler and drawing accurately, lay out the selected lines in the space given on page 19. If you have selected Fig. 1, make your squares $1\frac{1}{2}$ inch on a side. If Fig. 2, $2\frac{1}{2}$ inches. At home, cut a unit-like form which you have drawn, of such a size that it will fit into the spaces of your field on page 19.

Exercise XXVII.—Trace the units in their proper positions.

Exercise XXVIII.—Line in the design.

unit to the space at the right.

REPETITION OVER A SURFACE. Original Design.



TO BE USED AS THE TEACHER THINKS BEST.

REVIEW.—Equilateral Triangle and Square.

Review the triangle first on the slates and at the board, being sure that the pupils understand the meaning of the terms.



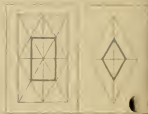
Exercise I.

In space above, sketch an equilateral triangle and its inscribed lines, as shown in illustration. First points one-half inch from lower corners of space. Line in the triangle. Fold paper triangle so as to obtain creases in positions indicated by light lines. Sketch and line in a circle concentric with the triangle, the sides of the triangle to touch.

Exercise 11

REVIEW.—The Oblong and Rhombus.

First cut the boxes of paper. Fold for diagonals and diameters. Fold in the eighth and division pupils about six copies.



Exercise III.

In the left-hand space sketch an oblong, placing points for its corners one-half inch from the corner of the space. Sketch its diameters, and connect their ends by light lines so as to form a rhombus. Sketch the diagonals of the oblong. Line in the small oblong. See illustration.

Exercise IV.

In the right-hand space sketch the diagonals for the rhombus extending them to within one-half inch of the sides of the space. Complete as shown in illustration.

NOTE. These exercises are given in this way to train the pupils to sketch accurately *free hand*. The light lines are to be considered, not as construction lines, but as "practice lines." Sketch, accurately, free hand, and the resulting shapes (to be lined in) will show clearly with what degree of

REVIEW.—The Octagon.

Insist upon free drawing and *uniform* work.

Exercise V. CONCENTRIC OCTAGONS.

In the space above, draw the figures in the order shown in small illustrations. First points one-half inch from corners of



Exercise VI. DICTATION.

Find center of space above. Through this point sketch the four diagonals for an octagon—units, diagonals. Sketch the octagon. Trisect each *non* diagonal. Use the inner thirds as diameters for a circle. Sketch the circle. Trisect each side of the octagon. Sketch lines from these points to the center. Line in circle. Line in outer circle. Line in radiating lines connecting sides of octagon with

THE HEXAGON.

For definition, see second page of cover.



Exercise III.

Instruction to the Teacher. Show models and objects (hexagonal prism, paper hexagon, a nut, perhaps a crayon, etc.) with hexagons. Pupils will to mind other objects and forms based on the hexagon.

Review the drawing of the equilateral triangle. Pupils draw on slates and board. Then show the pupils how the teacher may be drawn.

Exercise VII.

Place points one-half inch from the middle of the left and right sides of the space at the right. Connect points by a light horizontal line, and bisect it. Draw an equilateral triangle on each half of this horizontal line as a base, above and below the line. See small illustration above. Sketch the other





APPLICATION OF THE HEXAGON. A SIX-POINTED STAR.

Exercise IX.

Draw the six-pointed star in the space below in the manner indicated in small illustrations. First points one-half inch from middle of each side of the space. Be accurate.

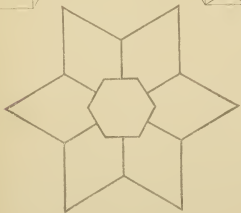


Exercise X

Draw the star upon the back of a card of colored paper, using the paper. Make the drawing the size of that drawn in Exercise IX. Cut out the star and paste in the space below.

APPLICATION OF THE HEXAGON.

Of what kind of design is this an application? What is the form of each unit? Why is a central form used?

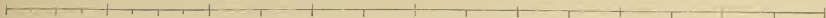


Exercise XI. A SNOW CRYSTAL.

Call to mind the forms of snow crystals. If possible, show two or three illustrations of them to the pupils. Analyze the figure to be drawn before beginning the drawing. Study the construction, as shown in small illustrations. Place points one half inch from the middle of the left and right sides of the space at the right. Sketch the hexagon as in Exercise VIII. Complete as shown in illustration.

NOTE.—Some excellent illustrations of snow crystals may be found in "Cloud Crystals, a Snowflake Album" (Appleton, N. Y.)

APPLICATION OF HEXAGON.
Enlargement from Copy and Dictation.



Exercise XII. SNOW
CRYSTAL.

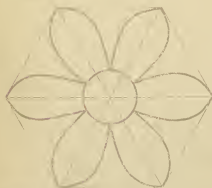
Enlarge as shown
in illustrations to fill
the space above. Use
ruler and draw



Exercise XIII.

Find center of space above. Through it sketch a horizontal line 4 inches long. This is the diagonal of a hexagon. Sketch the hexagon. Sketch the diameters of the hexagon and extend them one-half inch beyond each side of the hexagon. Upon each side of the hexagon sketch a circular curve connecting the ends of two diagonals, and passing through the end of an extended diameter line in these curves. Trisect each semi-diameter. Using the inner thirds as radii of a circle, sketch circles. Line to that

THE HELEAGGE IN NATURAL FORMS.



Exercise XIV.

Many of the forms in nature are based on geometric planes. Two illustrations of this are given on this page. One the leaf of a tulip tree. The other the flower of the anemone (conventional drawing of them.)

If possible, obtain a leaf of the oxalis (wood sorrel), and a flower of the saffron in the yellow crocus flower (hyacinth), and study those figures in the illustrations. Decide upon which you will draw. Sketch the construction lines.

Exercise XV.

Complete the drawing.

DRAWING FROM AN OBJECT.

Exercise XVI. On this page make a drawing from an object. A preserve jar, a kettle, or a long-handled dipper is suggested.

THE PENTAGON. See second page of cover for definition.

Exercise XVII. Build pentagon from models and objects. Arrange five sticks one and one-half inches long, so as to form a pentagon in the smaller space below. Place points at the corners, and, removing the sticks, draw the pentagon.



Exercise XVIII.

**Drawing the
Pentagon.**

Using the line
given in the space
at the right as a
base-line, sketch a
square, as shown

in illustration. Sketch its vertical diameter, and trisect it. Divide one vertical side of the square into six parts. From the upper point of trisection on the diameter draw the radiating lines of equal length, as



Exercise XIX.

To be enlarged in space below, as shown in illustration. Pupils make a pentagon from paper one and one-half inches on a side, and

use in obtaining position of figure in space. Sketch as shown in illustration.

Exercise XX.

In the space at the right sketch a design for a pentagonal silk-reel. That given above is bounded by straight lines. Your original design may be much better in shape.

APPLICATION OF PENTAGON.—DICTATION.

Exercise XXI.

Place points for a pentagon of any size so as to properly fill the space (see right). Sketch lines as follows: top point to lower left; top to lower right; upper left point to upper right; upper left point to lower right; upper right point to lower left. Line is a five-pointed star, and erase the excess of the light lines not used in forming the outline of the star.



Upon page 8 were given natural forms based on the hexagon—here are given two of the almost unlimited number of forms based on the pentagon. One an ivy leaf, the other the flower of the convolvulus.

Exercise XXII.

Study leaf forms based on the pentagon, and in the left space on page 13 make a conventional drawing of one—*i. e.*, draw the general shape—omitting all serrations and all veins but the midrib. (Currant, maple, woodbine, etc., are good examples.)



Exercise XXIII.

Study flower forms based on the pentagon. Make a conventional drawing of one in the right space on page 13. (The rose, apple, peach, and pear blossoms, blackberry, cherry, etc., are good examples.)

APPLICATION OF PENTAGON.

Exercise XXIV. DICTATION.

In the space at the right sketch a circle as large as the space will admit. (May use any help the teacher sees fit to suggest in obtaining the construction lines for this figure.)

Divide it accurately into five equal arcs. Using these points, sketch a star, as in Exercise XXI.

Bisect each arc of the circle. Connect the points thus found so as to form another star. Use in the ten points to form an outline line in the ten sides of the central figure, to form a decagon.

Draw radiating lines similar to those shown in Exercise XI.

The construction lines may be erased.

Exercise XXV.

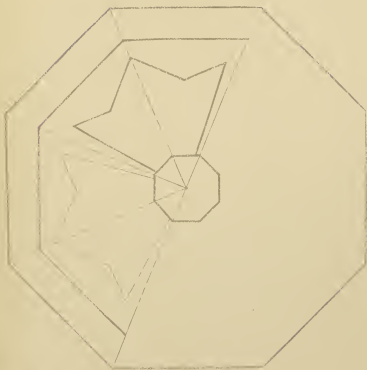
DRAWING FROM OBJECTS.

On page 15, make a large drawing from an object. A soup tureen or a cake basket or simple design is suggested. Or make smaller drawings from two objects. A goblet and a pitcher with straight sides are suggested.

DESIGN—REPETITION AROUND A CENTER

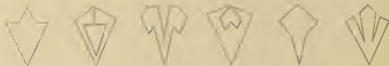
Units of design in these exercises consist of geometric forms, modified. In modifying a form, around the central theme of the original form.

DESIGN IN AN OCTAGON.



Exercise XXVI.

Complete the design above. Study carefully the construction of the design. Continue lines of the units, and notice what figures they form. Sketch design first, then line in with the finishing form. Use the rule (and eraser, if necessary) and make each an accurate drawing! It will be almost impossible to detect which is the design and which the printed one.

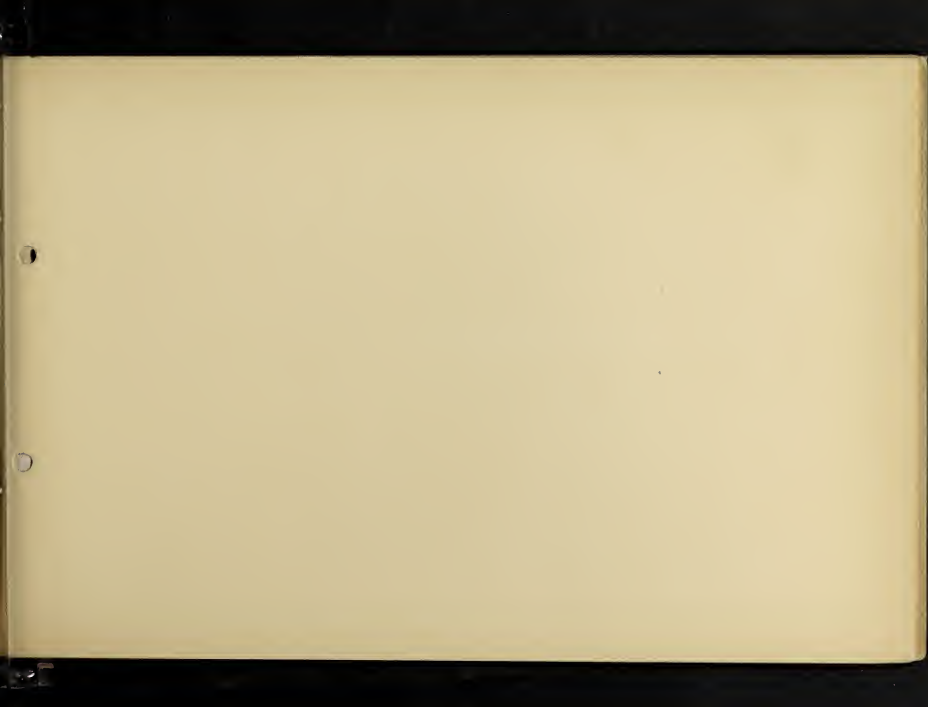


Using appropriate group as material for construction. Select one of these.



Exercise XXVII.

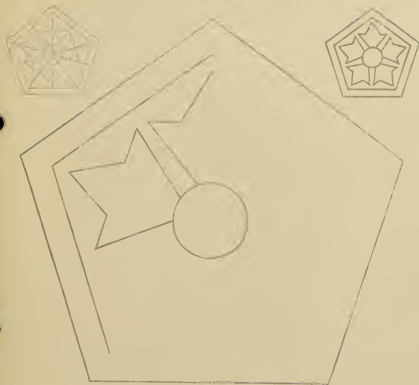
In this exercise, form from 3 shapes, using one of the units given at the top of the page. Repeat the rest as times. For relative sizes of units to space the previous design.





DESIGN.—REPETITION AROUND CENTER.

Design by F. Pentagone



Exercise XXVIII.

Complete the above design. Notice the construction-lines of the design, as shown in the upper left illustration. These may be sketched very lightly and the units lined in, or the units may be drawn simply by judgment of the eye. Of what kind of design is this an illustration? Why was a circular center used? A unit in design, is any single form complete in itself, to be regularly repeated in the design. Which is the more pleasing shaped unit, that used in this design or in the octagonal design? Why?

A SYMMETRICAL UNIT.

Exercise XXIX. COMPLETE THE UNIT.



REPETITION AROUND CENTER.

ORIGINAL UNIT.



Units based on the rhombus.



Units based on the trapezium.



The sketches show different modifications of geometric units. Select that which you think will make the best design. Compare it with the others. Why is it better adapted for design than any other?

Units which have *variety* in their outlines and *radiation* in their arrangement of parts are generally most beautiful. A horse chestnut leaf has both *variety* and *radiation*. See also the unit on page 17.

Exercise XXX. In the space at the right sketch an original unit.

Exercise XXXI. On the left half of page 19 draw accurately a square three and three-quarter inches on a side. (If the design is not to be also constructed of paper the square may be drawn five inches on a side, and in the center of the page.) Draw lightly construction lines, as shown in the design above. Find the proper size of the unit, and cut from manilla paper four units like that drawn on this page. Arrange them in their proper positions, and trace. Sketch also the central four.

Exercise XXXII. Finish the design—adding another square three tenths of inch square for the

Exercise XXXIII. Construct the design, using colored paper, on the right half of the page.

ORIGINAL DESIGN.

TO BE USED AS THE TEACHER THINKS BEST

THE CIRCLE

Exercises, problems, and other



Explain to have a paper circle four inches in diameter; and
 and circles of parchment, and with straws draw upon the
 disk, each circle. Fold the paper circle for diameter,
 being also. Turn the circle and draw connecting and great
 triangle drawing circle on the glass or paper.

Explain.

Explain to the circle, draw a circle. Place center marked
 and half of the circle at the center for points in the
 circle. To the circle draw a straight radius, and
 to the center of the circle part is straight, from the
 key.

REPRESENTATION OF OBJECTS.—From Objects.

Obtain blocks to illustrate this lesson, if possible. Have drawings made from them.



Exercise 7.

In the first space above, make a drawing from a washing. Sketch the horizontal diameter of the circle first; bisect it; sketch the vertical diameter; sketch the circle; then in, but add the little circles for the holes for the string. Boys to construct one from their knowledge. (Another hand, when it is possible, give with us, but need need better.

Exercise 7L.

In the second space above, make a drawing from a washer (see illustration). Sketch as in last lesson; first in the circle. Then, round out the circle around the string. To construct, cut two circles like the drawing from pasteboard and cover each with wax; place them back to back and sew them together around the string. If this method is to be worked, it should be made on one piece of the covering before it is sewed upon its circle of pasteboard.

The second picture is the drawing of a washing cut from thin red wax, the drawing of a washer with two holes, of pasteboard and covered with cloth, of the letter 'A' in the center, of the letter 'A' in the center, of the letter 'A' in the center.

APPLICATIONS OF THE CIRCLE

Any other application of the circle may be drawn instead of the fan, if desired.



Exercise VII

In space above, make a drawing of a fan as shown in illustration. Sketch the guide line first, as shown, placing the two points in the middle of the space. If possible have a real fan to illustrate the lesson. Be careful in placing points.

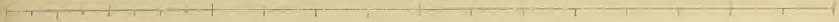
Exercise VIII

In the space above place a point in the center; through this point sketch a vertical line as shown. Half-inch at each side, through the same point sketch a horizontal line of equal length so that the lines may be perpendicular to each other. Sketch the circle. Draw the lower half of the vertical line. With the upper (previously) of this line as the radius draw a circle at another place, find the position and sketch its horizontal line.

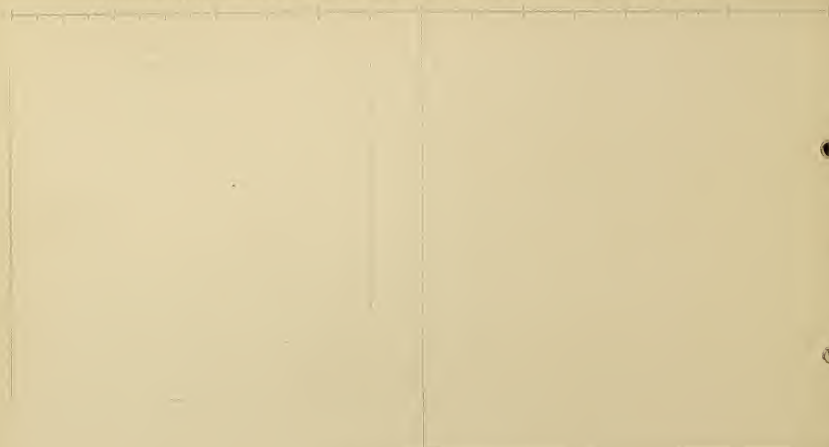


TO BE USED AS THE TEACHER THINKS BEST.

If necessary, in practice by making circles or circular curves.



The history of the United States from the first settlement to the present time, in two volumes. Vol. I. The first settlement to the year 1776. Vol. II. The year 1776 to the present time.



Chapter II.

The first settlement in America was made by the English in 1607. They were the first to establish a permanent colony. The first settlement in America was made by the English in 1607. They were the first to establish a permanent colony. The first settlement in America was made by the English in 1607. They were the first to establish a permanent colony.



Chapter III.

The second settlement in America was made by the French in 1608. They were the first to establish a permanent colony. The second settlement in America was made by the French in 1608. They were the first to establish a permanent colony. The second settlement in America was made by the French in 1608. They were the first to establish a permanent colony.

APPENDIX OF CONSTRUCTION AND MEASUREMENT.

It is to be observed, that the scale of the drawing is 1/2 inch to the foot. The drawing is to be made to the scale of the drawing.



EXAMPLE III.

To construct a circle passing through a given point, and touching a given line. (See Fig. 1.)
 Let the given point be *A*, and the given line be *BC*. Draw a line *AD* perpendicular to *BC*, and bisecting it in *D*. With *D* as center, and *AD* as radius, describe a circle. This circle will touch the line *BC* at *E*, and pass through *A*. The required circle is described.



EXAMPLE IV.

To construct a circle passing through a given point, and touching a given line. (See Fig. 2.)
 Let the given point be *A*, and the given line be *BC*. Draw a line *AD* perpendicular to *BC*, and bisecting it in *D*. With *D* as center, and *AD* as radius, describe a circle. This circle will touch the line *BC* at *E*, and pass through *A*. The required circle is described.

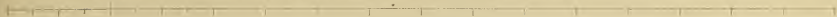
Following points to be filled

Exercise 107. On the given intervals (marked from 0 to 1) divide the interval into 10 equal parts. Make the division with thought to multiply by 10 the space

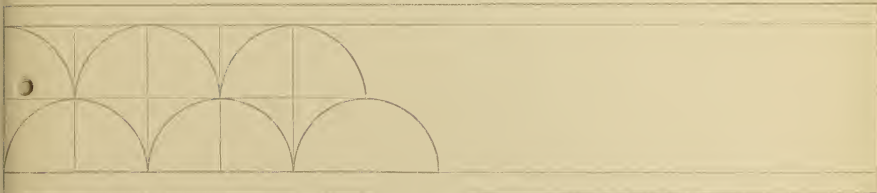


APPLICATIONS OF CIRCLES, SEMICIRCLES, AND QUADRANTS IN DESIGN.

Of what kind of design are these examples? What is the unit used in each? A rule may be used in drawing the guidelines, if necessary.

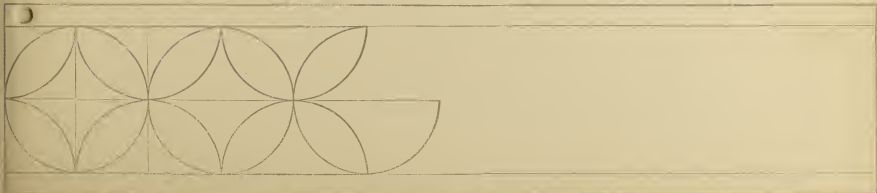


To be Completed.



Exercise XV. Sketch the guide-lines first, then the semicircles. Leave the guide-lines in the drawing, and line in the border as indicated.

To be Completed.



Exercise XVI. Sketch the entire flower. Sketch with the ruler and compass first, then the semicircles, and finally the circles. Measure the guide-lines, and line in the border.

THE ELLIPSE. For definition, see second page of cover.

Draw an ellipse upon the blackboard, using string and pins; compare with a needle. An ellipse has two diameters—a long and a short—and two foci (focus) of focus.



Exercise XVII.

Draw the ellipses drawn on the board with the string and pins. In the illustration 1 shows the position of one focus, and 2 of the other. The string is 1-2 and 2-1. On the same or another position, 1-3 and 3-2. Remember that the real length of the string does not change. In space above, using the guide-lines given, sketch two ellipses.



Exercise XVIII.

Practice drawing ellipses upon blackboard and sheet of paper, with and without the diameters as guide-lines. Before to draw the whole ellipse with one movement of the whole pen. In the space above, draw two ellipses, using the guide-point given, without sketching the diameters.



ELLIPSES AND APPLICATIONS.

The four quarters of an ellipse must be alike. Remember this in drawing Exercise XIX.



ELLIPSES PLACED OBLIQUELY.

Exercise XIX.

In the space above, draw three ellipses upon the diameters given as guide-lines. Notice that the two diameters of an ellipse are *always* at right angles to each other, and *always* bisect each other, no matter what the position of the ellipse may be. Practice drawing oblique ellipses without sketching their diameters.



Exercise XX.

In the illustration is represented a sprig of plums. In the space above, draw the three plums in the positions indicated. Sketch the ellipses entire first, then line in such portions of each as are required. Question pupils as to the growth of the plum-tree. Ask about other plants which bear elliptical fruit.



APPLICATIONS OF THE PLANE.

Think of other applications of the plane. One or more may be drawn in the right-hand space, if the direction given is followed.



PHOTOGRAPHIC FRAME.

Frames constructed by the pupils from their drawings.

Exercise XXII.

Draw picture one-half inch long and three-fourths of an inch wide. Sketch the frame, square its corners, by the diagonals. These points make proper positions for the frame (see illustration). Engrave illustration and fasten. May be constructed using paste-board or wood, and covering with cloth or painting it.

Exercise XXIII. IMITATION AND BOARD.

Sketch a long and short diameter for an ellipse, as large as the second space of right will long. Sketch the ellipse. One-half inch inside the first ellipse, sketch a smaller ellipse. This pattern half above the one diameter of the smaller ellipse, sketch a horizontal line. The sides of the ellipse connect with lines the same diameter long. In other words, draw a line in an oval, and add a line to connect it with a brace between the sides.

Exercise XXIII.



GREEK ASTRAGAL.
From the Temple of Erechtheus at Athens

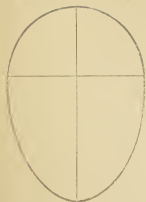


ROMAN ASTRAGAL.
From the Arch of Titus at Rome

[illegible]

THE OVAL AND APPLICATION. For definition, see second page of volume.

Compare the figure with circle and ellipse. An oval is not necessarily composed of a semicircle and a semicircle.



Exercise XXIV.

Practice drawing ovals upon glass and paper, with and without guide lines. In space given, draw two ovals using the guide-lines; the guide-lines may be sketched. If necessary. What two figures are united to form the oval shown in illustration?



Exercise XXV.

Make the drawing from a real specimen. Study it carefully before beginning to draw. Place the two ends parallel, as shown in illustration. Secure the irregular line that defines each body of the egg; make sure it is within one-half inch of a true circle. Then finish sketch the second illustration.

APPLICATIONS OF THE OVAL IN HISTORIC ORNAMENT.

Various forms of the Echinus Molding.

I. The Egyptian ornament which probably suggested the form of the Greek Echinus,—about 1200 B. C.

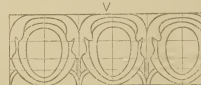
II. Greek Echinus—about 400 B. C. From the Temple of Apollo, at Miletus.

III. Roman Echinus—first century. From the Arch of Titus, at Rome.

IV. The Byzantine Form—sixth century. From the Church of St. Sophia, at Constantinople.

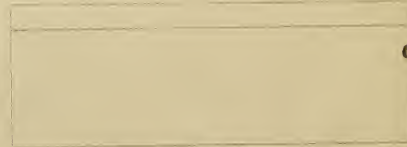
V. The Renaissance Form—sixteenth century. From the Church of St. Eustache, at Paris.

DIRECTIONS. Within the upper oblong given may be drawn, either the Egyptian or Renaissance moldings, as shown in illustrations. Should the Egyptian be selected, draw a series of horizontal lines parallel to the horizontal lines already drawn, starting them at the several points indicated; but if the Renaissance molding is chosen, these lines will be unnecessary. Any of the other moldings may be drawn in the lower oblong. First, let each of the oblongs be divided with light parallel, vertical and horizontal guide-lines, as shown in illustrations. Second, proceed to sketch the moldings with a free, soft line. Third, erase guide-lines, and line in with a free, bold line.



Exercise XXVIII.

Enter the Egyptian or Renaissance Form.



Exercise XXIX.

Enter the Greek, Roman, or Byzantine Form.

NOTE. Take special notice of the difference of the diameters of the oval series in these moldings.

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DRAWING FROM AN OBJECT.

Exercise XXX. On this page, make the drawing from some object containing an oval or an ellipse. Make the drawing large enough to suitably fill the space.



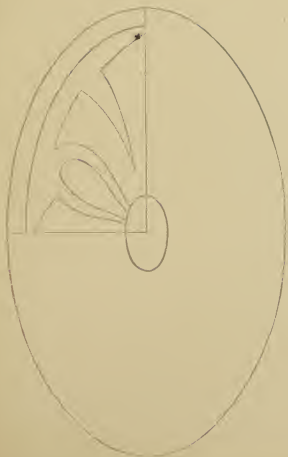
MEMORANDUM AND NOTES.

Example XXII. In the following cases, make a memorandum of some former business transacted in the trade. Example XXIII. In each case, make a memorandum of some former business transacted in the trade. Example XXIV. In each case, make a memorandum of some former business transacted in the trade. Example XXV. In each case, make a memorandum of some former business transacted in the trade. Example XXVI. In each case, make a memorandum of some former business transacted in the trade. Example XXVII. In each case, make a memorandum of some former business transacted in the trade. Example XXVIII. In each case, make a memorandum of some former business transacted in the trade. Example XXIX. In each case, make a memorandum of some former business transacted in the trade. Example XXX. In each case, make a memorandum of some former business transacted in the trade.

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DESIGNS, CONTAINING SQUARES, RECTANGLES, OVALS, ETC.

Example. Copying the design as revealed on the ellipse. Sketch guidelines first.



Exercise 10.

Sketch one of the four designs in the four ovals as originally given, then draw the four ovals and the four designs in the four ovals as they appear when the four ovals are drawn as circles and the four designs are drawn as circles.

of these the half - inch is repeated around the circle. (Draw the circle) and the design, and line in the circle as well as the circle.

TO BE USED AS THE TRAVELER TRIPLET CASE.

For Record of Observations.



WHITE'S INDUSTRIAL DRAWING—REVISED.

NUMBERS ONE TO EIGHT.

Book Number One embraces the work of the first half of the first school year, and is intended for the use of teachers. In it the general analysis of the lessons is laid down, the materials to be employed are enumerated and described, and methods are given with some detail. A prominent feature of this book is the complete exposition of the proper use of clay and clay modeling in the teaching of form to young children. The work of each week is designated, and a sufficient number of illustrations given throughout the book to make clear the author's meaning at every point.

Book Number Two (second half of first school year). According to the plan of the series, this is the first book which is to be placed in the hands of the pupils. Beginning with training pupils to judge distances, it proceeds with straight lines and applications; the division of lines and their relations; and includes the construction of a number of simple objects which the pupils are supposed to make.

Book Number Three first reviews the principles taught in the previous book, and teaches the angles and their applications, both in objects and in symmetrical figures; of triangles, with their applications, and the construction of objects based thereon, and concludes with the symmetrical repetition of triangular forms, as seen in borders, etc.

Book Number Four, after reviewing the principal elements embraced in the previous book, continues with triangles and their applications, and takes up the square, its parts, divisions, and applications, and introduces memory drawing, dictation, and drawing from the object. In this, as in the previous books, a number of examples are given, which the pupils are required to construct from their own drawings.

Book Number Five extends the work of Book Four, and takes up the drawing and construction of somewhat more difficult objects; the oblong, and six-pointed and eight-pointed stars; while the application of each of these figures in objects and decoration is introduced.

Book Number Six reviews the principles of Number Five by having the pupils draw and cut out familiar objects based upon the square and the oblong. The rhombus, its application in object drawing and decoration, are given, and the construction of the octagon and hexagon is shown, with practical applications; and as a special feature of this book, the principles of radial design are illustrated. Opportunity is given in this, as in other books, for memory drawing, dictation drawing from the objects, and for examination.

Book Number Seven introduces a method of drawing the pentagon, its applications in familiar objects and in decorative design; and also here, for the first time, begins the systematic study of simple curves. The treatment of curves is original and practical, and the applications given are of the most valuable and instructive kind. Radial ornament is further illustrated, and elements are given from which the pupils may select for original arrangements.

Book Number Eight introduces the circle and its parts, with practice in drawing free-hand circles as employed in ornament and in the drawing of objects. The ellipse and the oval are taught; and in this book, for the first time, an instructive study of some of the simpler principles of historic ornament is taken up.

THE ALPHABET OF MANUAL TRAINING.

❖
WHITE'S INDUSTRIAL DRAWING
↗ REVISED ↖

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The use of objects in teaching and the making of objects drawn are distinguishing features of the system.

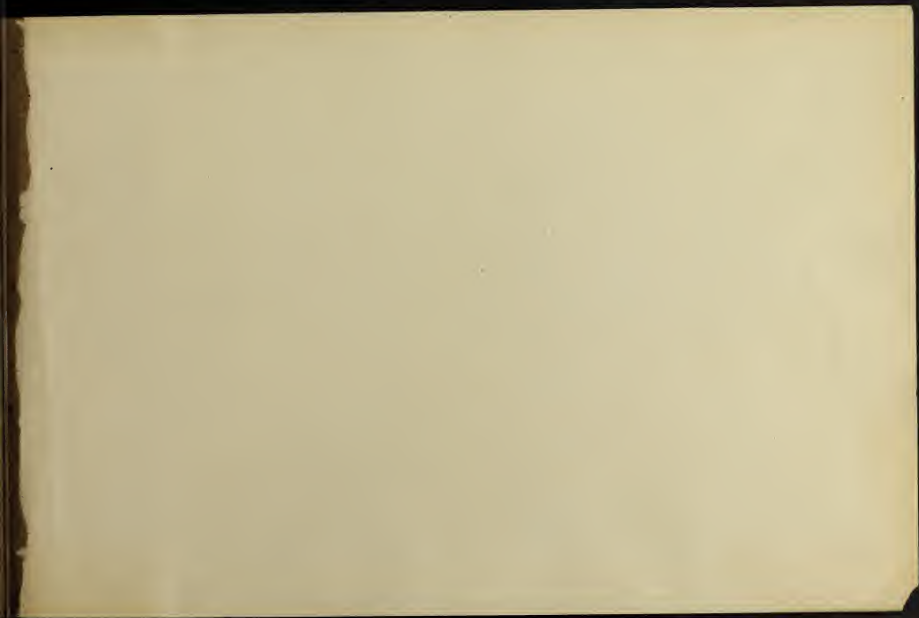
NUMBERS NINE TO EIGHTEEN.

The work introduced in the lower numbers is continued and extended, and the more technical subjects are introduced in their appropriate places. While drawing from objects has been followed from the first, the representation of similar objects in free-hand perspective is skillfully treated in the later books. Drawing to scale for the purpose of construction is systematically taught, and this work is of the most practical character. The study of historic ornament, through the analysis of classic design, and the consideration of original ornament are fully treated, and by a series of comparative illustrations, the work in this department is of the most instructive character. See covers of larger books for detailed description of each. [For description of first eight Numbers see third page of cover.]

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